

FARMING OR FORAGING?

Household Labour and
Livelihood Strategies Amongst
Smallholder Cocoa Growers in
Papua New Guinea



by **G. N. CURRY**, **G. KOCZBERSKI**,
E. OMURU and **B. S. NAILINA**

Studies in Australia, Asia and the Pacific

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University of Technology

FARMING OR FORAGING?

Drawing on household level studies of cocoa production amongst village communities in Papua New Guinea's Gazelle Peninsula, *Farming or Foraging?* presents a socio-economic and cultural model of smallholder productivity. The book discusses how commercial sector organisations can be drawn upon to provide smallholder extension strategies that are better integrated with the livelihoods of village producers. This book will be of value to researchers and agricultural extension organisations working with smallholders in developing countries across a range of different cash crops.

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STRATEGIES AMONGST SMALLHOLDER
COCOA GROWERS IN PAPUA NEW GUINEA

by

G.N. Curry, G. Koczberski, E. Omuru and R.S.

Nailina

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Abbreviations and Acronyms

ACIAR	Australian Centre for International Agricultural Research
ADB	Asian Development Bank
CCEA	Cocoa Coconut Extension Agency
CCI	Cocoa Coconut Institute
CSF	Cocoa Stabilisation Fund
CSP	Commercial Service Provider
DIS	Delivered-in-Store
DPI	Division of Primary Industry
ENB	East New Britain
FOB	Free-on-Board
IMF	International Monetary Fund
LAES	Lowlands Agricultural and Experiment Station
LLG	Local Level Government
LSS	Land Settlement Scheme
NE	Nucleus Enterprise
PNG	Papua New Guinea
SLA	Sustainable Livelihoods Approach
SG 2	Seed Garden 2
UK	United Kingdom
USA	United States of America
VSD	Vascular Streak Disease
WNB	West New Britain

Chapter 1

Introduction

Cocoa production in Papua New Guinea (PNG) is a major industry involving over 150,000 families in the coastal and island regions of the country. According to the 2000 National Population Census cocoa producing households represent 31% of households in the cocoa producing regions and 16% of the total number of PNG households. Most households producing cocoa are also dependent on subsistence agriculture for their livelihoods. In recent decades dependence on cash has increased markedly due to rising material aspirations and economic development. Higher standards of living are being sought as lifestyle values change and cash is increasingly required to meet the costs of education, health and other goods and services (Lummani, 2003). Cash has also become an indispensable item in many non-market exchange transactions such as brideprices, mortuary and compensation payments and other social obligations determined by kinship. Hence, the cash income earned by smallholder cocoa producers contributes significantly to meeting the material needs and social obligations of households and communities.

This monograph presents the results of a three-year study of smallholder cocoa production on the Gazelle Peninsula in East New Britain (ENB) Province, PNG. ENB Province, and the Gazelle Peninsula in particular, is a major producer of cocoa. Between 1994/5 and 2002/3 approximately 54% of national smallholder cocoa production was from ENB (Cocoa Board of Papua New Guinea data). Yet, despite its dominance in national production and high smallholder productivity relative to other cocoa growing provinces, smallholder yields in ENB are well below potential levels.

The monograph arises from a long-held concern among industry stakeholders about the relatively low productivity and incomes of cocoa smallholders. A long-term sustained research program in cocoa breeding and pests and diseases together with the presence of a cocoa extension program have had only minimal impact on improving smallholder yields and incomes, due in part to the low uptake of new technologies and extension advice. The purpose of this book is to document the main socio-economic factors constraining smallholder production and productivity and to use this information to design research and extension services to raise smallholder productivity and incomes. We argue that with an appropriate extension program tailored and integrated with the

livelihood strategies of smallholders, there are opportunities for considerable increases in smallholder productivity without the need to expand the area of land under cultivation. The latter option of increasing the area of cocoa cultivation is no longer viable for PNG given high population growth rates and limited availability of land for further expansion of cocoa.

To investigate the constraints on smallholder cocoa productivity the research approach placed an emphasis on understanding the social and cultural context of smallholder cocoa production, particularly intra-household decision-making. This is important in the PNG context where smallholder producers depend largely on family labour for harvesting and farm maintenance tasks. Focusing on the organisation and management of household labour enabled a fuller picture of the range of socio-economic factors influencing cocoa production to emerge. Further, such an approach recognises that smallholder production is embedded in broader social and cultural systems that influence the decisions made by smallholders. This approach moves away from the more conventional technical and top-down research approaches commonly used to examine smallholder productivity issues in the developing world. Understanding the socio-cultural context in which smallholder practices and decisions are made enables sustainable solutions to be found that address the low productivity and incomes of smallholders in a way that accommodates their life world and priorities. As Vancley notes in relation to agricultural extension more generally (2004, p.213):

Agriculture has too long been thought of as a technical issue involving the application of science, and the transference of the outputs of that science via a top-down process of technology transfer. It is not. Agriculture is farming, and farming is people. The survival of agriculture is dependent on the survival of viable rural communities. Sustainability has multiple bottom line implications, containing environmental, social and economic dimensions. The criteria and indicators for sustainability in a physical sense are generally understood. The economic indicators are also well established, although rather limited. What is lacking is an awareness of the social issues.

The emphasis on the household and the socio-cultural context of production in this study sits within a broader research framework that draws on the Sustainable Livelihoods Approach (SLA) (Chambers & Conway, 1992; Ellis, 2000). SLA provides an analytical framework for understanding smallholder

livelihoods. Although the SLA was originally developed as a tool in development planning to assist in poverty alleviation, the approach has much to offer smallholder research and planning. For example, the SLA serves to identify the constraints and opportunities that shape peoples' livelihood options. It also encourages a broader perspective to investigate and think about the diverse livelihood strategies in which most smallholders are engaged. Some earlier research approaches tended to view smallholder commodity production in isolation of other household livelihood strategies that influence production strategies. For instance, cocoa producers were commonly perceived as solely cocoa producers, and the diverse range of other livelihood practices were ignored. By livelihood strategies we refer to the "range and combination of activities and choices that people make/undertake in order to achieve their livelihood goals" (DFID, 1994, p.33): these goals being household wellbeing, economic security and social stability. Cocoa production is but one of a range of livelihood strategies in which smallholder cocoa households are engaged.

Key features of the SLA is its recognition of the heterogeneity within rural communities, the diversity of economic and agricultural strategies among and within rural households, and the role of access to resources and assets in creating and sustaining people's livelihoods.

Several features of the SLA make it a suitable framework for analysing smallholder cocoa production. These include:

- placing people and households at the centre of the research, thereby encouraging a participatory approach;
- recognising that people pursue diverse livelihood strategies (commodity production is just one of a broad range of livelihood strategies);
- seeking to understand the factors enhancing or constraining people's choice of livelihood strategies (social and cultural variables in addition to economic variables are important for this understanding);
- seeking to understand the constraints on particular livelihood opportunities (e.g., inability to access credit);
- acknowledging the multiple influences on people's livelihood strategies (e.g., influence of national and local government policies, market access and social and cultural factors); and,
- taking a multi-method approach to researching the factors influencing people's livelihood choices and activities.

This broader approach to investigating smallholder production enables a more holistic understanding of the range of factors affecting smallholder production

to develop, which in turn increases the probability that the recommendations emerging from the research will reflect the needs and priorities of smallholders and, therefore, be more successful than previous top-down initiatives to raise smallholder productivity.

Three decades of smallholder research on the Gazelle Peninsula point to a set of persistent problems that have been known by the industry for a long time. These constraints are described in Chapter 3 and include labour shortages, low levels of block maintenance, land shortages and low cocoa prices. Despite awareness of and attempts to overcome these constraints there have been no lasting solutions to low productivity and incomes of growers. The present study has sought to investigate and explain the social and economic factors underlying these on-going problems, rather than to simply document their continued presence. To this end Chapters 4, 5, 6 and 7 examine:

- land tenure;
- household labour and cocoa production strategies; and,
- farm management practices (in particular pest and disease management practices).

Chapter 8 investigates the interrelationships amongst the main factors affecting productivity and incorporates them in a Model of Smallholder Production. The Model reveals that the age of a cocoa stand is a key determinant of block condition including its vegetation structure, degree of shading and level of infestations with pests and diseases. The typical smallholder cocoa block receives little or no pruning and shade control, and there is virtually no management of pests and diseases. Poor accessibility also leads to a significant amount of under-harvesting on older cocoa blocks thereby adding to the reservoir of disease inoculant. Thus, the age of a cocoa stand determines block condition which in turn influences labour inputs through the adoption of particular production strategies by households.

The Model of Smallholder Production described in Chapter 8 identifies three development stages of the cocoa block — immature, mature and senile — each with its own distinctive set of vegetational structural characteristics, pest and disease levels, degree of accessibility for harvesting, quantity of accessible healthy, ripe crop available for harvesting, and smallholder production strategy. There are two broad production strategies followed by smallholders: the low labour input *foraging* strategy in which cocoa is harvested and sold as wet bean; and the higher labour input *farming* strategy usually associated with dry bean processing. Because labour inputs in block maintenance are generally low,

especially for pruning and shade control, cocoa blocks typically enter the very low productivity *foraging* phase prematurely at around 7 or 8 years of age. With the exception of Bougainville, where there recently has been a large-scale replanting program following the civil war, most cocoa blocks in PNG are more than eight years old and are therefore locked into a foraging production strategy in which recurrent income is insufficient to finance replanting. Blocks under a foraging strategy have fewer ripe healthy pods for harvesting, creating further disincentives for smallholders to invest time and labour in harvesting and block maintenance.

More importantly, the Model provides a conceptual framework for understanding smallholder production strategies that can be used for developing policy initiatives to address some of these long-standing problems. Potential new policy directions are described in Chapter 9. These include initiatives which involve the commercial sector working in partnership with smallholders for the delivery of extension services to growers. It is argued that the commercial sector should take more responsibility for the delivery of extension and other services to growers.

The rest of this chapter provides an overview of the cocoa industry in PNG. The discussion focuses on plantation and smallholder production and some of the key trends and industry policies affecting smallholder production. This provides the context for the detailed household-level analyses that follows in later chapters.

The arrival of cocoa in Papua New Guinea

German traders introduced cocoa to PNG around 1900. Development of the industry was slow in the early years, and by 1940 annual exports had reached only 200 tonnes (PNG Export Tree Crop Study, 1987). The Australian colonial administration promoted the rapid expansion of the industry in the 1950s by encouraging smallholders to plant cocoa. National production grew rapidly from the 1950s to the mid-1970s, and despite the participation of smallholders in the industry, most of this growth was from the plantation sector which dominated cocoa production until 1977 (PNG Export Tree Crop Study, 1987). Plantation production fell rapidly thereafter following independence due mainly to the neglect of plantations during an extended period of low prices and an escalation in land tenure disputes, while smallholder production continued to expand, thus altering the structure of the industry.

The cocoa industry contributes to the PNG national economy largely by providing employment and income for rural households, and by generating foreign exchange. In addition, there is substantial indirect employment in the service and processing industries. In the mid-1980s the cocoa plantation sector directly employed an estimated 8,000 people (PNG Export Tree Crop Study, 1987). In coastal regions of the country 31% of households are involved in cocoa production (National Statistical Office, 2001).

There is scarce information on annual household income from cocoa. In a 2001 study in East New Britain Province, the average annual income per farm household from cocoa was K2,867 (in 2001 K1=A\$0.55), made up of dry bean sales of K2,803 and wet bean sales of K64 (Omuru *et al.*, 2001). Lummani (2006) estimated average annual household cocoa incomes in the Buin District of Bougainville to be K716, made up of dry bean sales of K447 and wet bean sales of K269.

Export revenue from cocoa bean exports fluctuated greatly in the period from 1981 to 2004 in response to changing prices. Between 1981 and 1990 cocoa was second to coffee as the main export crop in PNG, with average annual export earnings of K47 million. From 1991 to 2000 export earnings from cocoa grew to an average of K60 million per annum, and from 2001 to 2004 increased to K205.63 million per annum. Annual export earnings for cocoa reached their highest level in 2003 at K258 million, which amounted to 19% of the total export earnings from agricultural products. PNG's total cocoa export revenue for 2005 was K199 million, representing 17% of the total share of export revenue from the major export tree crops (Bank of Papua New Guinea, 2006). While the total value of cocoa exports has increased, cocoa has dropped to third rank in its overall significance to the PNG agricultural economy, after oil palm and coffee¹ (Bank of Papua New Guinea, 2006).

Despite relatively better prices in the second half of the 1990s, annual production has stagnated between 30,000 and 40,000 tonnes thus limiting any major growth in export earnings from increases in volume (average annual production is 36,000 tonnes). In 2005, cocoa export volume was 44,200 tonnes compared with 36,500 tonnes in 2001 (Bank of Papua New Guinea, 2006).

Trends in the PNG Cocoa Industry

The review of market and industry trends for cocoa in this section is in five parts: prices; production and productivity; production costs; exports; and government and industry policies concerning price stabilisation.

Domestic Cocoa Prices

Figure 1.1 shows domestic cocoa exports (free-on-board) (FOB), delivered-in-store (DIS) prices in nominal terms and the level of government levy/bounty over this period. Prices rose steadily in the mid-1970s and reached a peak in 1978/79 before declining and remaining stagnant for much of the 1980s and early 1990s. Prices then rose rapidly to peak in 1998 at over K3,000 per tonne before dropping to around K2,000 per tonne in 2000. Prices rallied strongly in 2001 and 2002, reaching their highest levels in 2002 and have remained relatively high in recent years. In 2006, FOB cocoa prices averaged K4,624 per tonne and DIS prices K4,049 per tonne. Relatively high prices over recent years are mainly a consequence of the political uncertainties in the Ivory Coast, the world's largest cocoa producer.

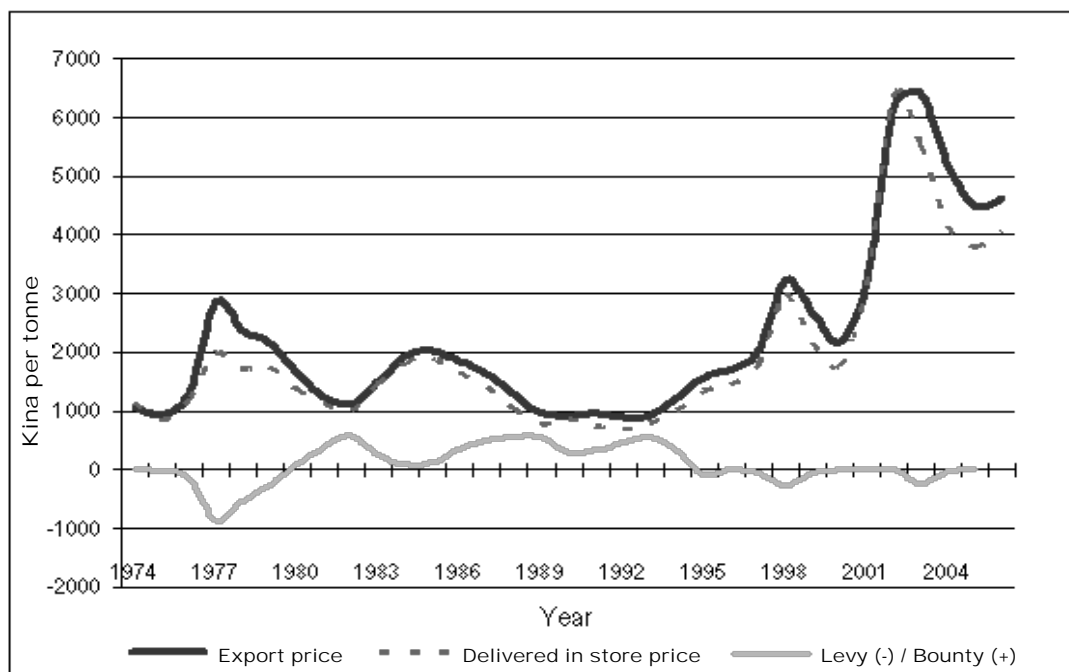


Figure 1.1. PNG cocoa prices and levies/bounties (1974-2005) (source: Cocoa Board Statistics).

In general, domestic prices increased significantly from 1994 primarily as a result of the devaluation of the Kina in September 1994 and the floating of the Kina since October the same year, as part of an International Monetary Fund (IMF) stabilisation programme. Further depreciation of the Kina against the US

dollar and other major currencies resulted in price increases until 1998/1999 when prices began to decline due to lower international prices.

In addition, prices received by producers from the mid-1980s to 1994 were subsidised, firstly by bounty payments from the cocoa stabilisation funds (mid-1980s to 1989) and secondly from loans provided by the government to each commodity industry (cocoa, copra, coffee and oil palm). The loans were introduced in December 1992 as part of an agricultural price guarantee scheme for a five-year period (1992-1997)² when the stabilisation funds were exhausted in 1989/90.

Cocoa Production and Productivity

Cocoa in PNG is produced by plantation companies and village smallholders. Plantation production stagnated between 8,000 and 15,000 tonnes from 1977/78 to 1987/88, then increased sharply in 1988/89 (Figure 1.2). It has been declining since then. Some factors contributing to this decline include the (Omuru, 2003):

- collapse of production from Bougainville which was producing about 36% of the total plantation cocoa output prior to civil unrest in 1988/89;
- lack of additional land for expansion; and
- increasing costs of production.

Smallholder cocoa production, in contrast, grew from 6,800 tonnes in 1972/73 to 29,500 tonnes in 1988/89. Production fluctuated between 15,000 and 30,000 tonnes between 1991/92 and 2000/01 but recovered strongly from 2001/02, reaching an all time high of 39,082 tonnes in 2002/03. Since then, smallholder production has fluctuated reaching a peak of 40,141 tonnes in 2004/05 (Figure 1.2).

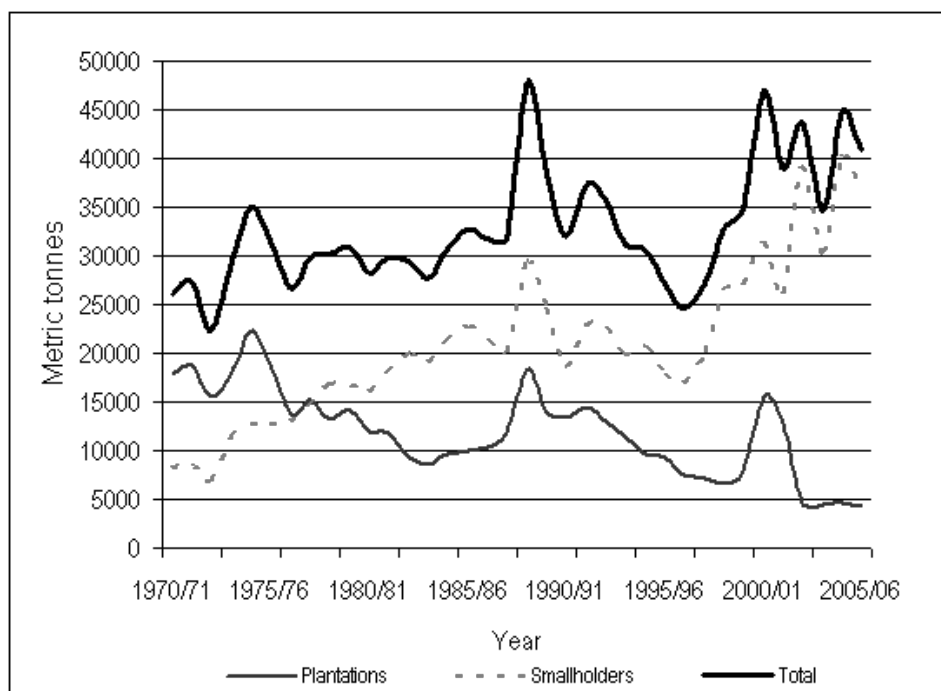


Figure 1.2. Cocoa bean production by sector in PNG from 1970 to 2005/06 (source: Cocoa Board Statistics).

Trends in Production Costs

Cocoa plantation costs of production are summarised in Table 1.1. Average costs of production in real terms for cocoa plantations fluctuated from 1995 to 1998 with a slight decline over the period. The average cocoa plantation production cost from 1995 to 1998 was K1,870 per tonne in nominal terms and K2,150 per tonne in real terms (1998 Kina values).

Table 1.1. Average costs of production per tonne 1995-1998.

Cocoa costs of production	1995 ^a	1996 ^b	1997 ^c	1998 ^c	4-year average
Real (1998) Kina values	2042	1827	2908	1823	2150
Kina/tonne (nominal)	1550	1547	2560	1823	1870

Sources: ^a Fripp (1996); ^b Omuru (1997); and ^c Omuru & Lummani (2001).

A 2001 survey of 44 cocoa plantations provides the most recent estimate of costs of production (Table 1.2). The highest cost component was overhead/fixed costs, which were 55.3% of total costs, followed in declining order of share of total costs by “mature upkeep/field variable costs”, “processing and despatch costs” and “harvesting costs” (Table 1.2).

Table 1.2. Average cocoa plantation costs of production in PNG, 2001.

Major cost category	Kina per tonne	%	Kina per hectare	%
Overhead/fixed costs (a)	1,916 (702)*	55.3 (702)*	652 (351)	62.6 (702)*
Mature upkeep/ field variable costs (b)	804 (582)	23.2 (582)	274 (290)	26.3 (582)
Harvesting costs (c)	340 (291)	9.8	116 (145)	11.1
Processing & despatch costs (d)	406 (246)	11.7		
Total cost of production (a + b + c + d)	3,465 (1,823)	100	1,041 (786)	100

Source: Omuru, 2003.

* For comparative purposes, the production costs for 1998 are shown in brackets.

Cocoa plantation costs of production increased by 90% from 1998 to 2001. This is partly attributable to the 34.6% fall in plantation cocoa yield over the same period. Moreover, all major cost categories registered increases ranging from K49 per tonne (17%) for harvesting to K1,219 per tonne (173%) for overhead/fixed costs. Processing and mature upkeep had cost increases of K160 per tonne (65%) and K222 per tonne (38%), respectively. However, on a *cost per hectare* basis, mature upkeep and harvesting costs actually had decreases of 6% and 20%, respectively mainly because of the large drop in yields over this period. The increase in overhead costs was 86%.

For the smallholder sector, the average costs of production per tonne and profitability for smallholders in ENB in 1999 are summarised in Table 1.3. The average total cost of production for the cocoa sample in 1999 was K447.48 per tonne. A major cost to smallholder producers was transporting the cocoa to exporters in Kokopo/Rabaul: K182.66 per tonne, or 41% of total production costs. The second most important cost category was processing, which accounts for K101.91 per tonne (23%). Remaining costs were shared between harvesting and field variable costs (Table 1.3).

Table 1.3. Average cocoa costs of production and margins for ENB smallholders in 1999.

Cost category	Cocoa (Kina per tonne)	% of total cost of production
Field variable cost	78.10	17.4
Harvesting	84.81	19.0
Processing	101.91	22.8
Transport	182.66	40.8
Total cost of production (a)	447.48	100
Estimated producer price (b)	2,162 ^a	
Net margin (income) [(b)-(a)]	1,715	

Source: Omuru, 2003. ^a Average delivered-in-store price (Cocoa Board 2000).

Cocoa Exports

All cocoa produced in PNG is exported as dried bean. Until the 1991/92 cocoa year, over 90% of dry bean was exported to Western Europe and North America, with Germany, Belgium, the United Kingdom (UK), the Netherlands and the United States of America (USA) being major buyers. Since then, Singapore has become a major buyer of PNG cocoa and together with the USA accounts for about half of PNG's total cocoa exports (Cocoa Board of PNG, 2005).

Government and Industry Policies

Government intervention in the cocoa industry has been mostly in price stabilisation and/or direct price support. Various forms of price stabilisation schemes have been implemented since independence in 1975. Price stabilisation schemes have aimed to give producers a stable income and a guaranteed minimum price to provide producers with incentives to maintain production during low commodity price cycles. Price stabilisation policies assumed that a minimum producer price would ensure that smallholders would receive a return at least on par with the minimum rural wage and that of plantations. This assumption formed the basis of a stabilisation levy and bounty schedules. Levies were collected from producers and accumulated in a Cocoa Stabilisation Fund (CSF) when the price exceeded a certain floor price or the cost of production. Bounties were paid to producers when the market price fell below the guaranteed floor price to offset the difference between the prevailing market price and the floor price.

Until May 1980, cocoa prices were above the set threshold level and levies were collected. At the time the CSF, including interest generated, reached a total of K62.9 million. In the early 1980s prices fell rapidly to below the

threshold level, resulting in bounties being paid out from the CSF to stabilise producer prices (Figure 1.1). Prices remained low or fluctuated for most of the 1980s, and draw-downs continued until the CSF was fully depleted in May 1989 (Omuru, 1996). To maintain producers' welfare and sustain production, the Cocoa Board obtained a government guaranteed loan to pay bounties to farmers. However, the Board was unable to make timely repayment and the resulting outstanding loan of K26 million was written off by the National Government in December 2006.

Apart from the various forms of price stabilisation schemes, there have been no overall major policy changes to date, although efforts to review policy issues were addressed at a National Cocoa Summit of cocoa industry stakeholders held in July 2003 at Vunapope in the ENB Province. The purpose of the summit was to allow industry stakeholders to highlight the major challenges facing the industry and to address priority areas, including the need to review the Cocoa Board Act. Nothing to this effect has yet eventuated. Presently the most immediate challenge to the cocoa industry is the incursion in 2006 of the Cocoa Pod Borer *Conopomorpha cramerella* into the country. This pest has the potential to cause losses of 80-90% to the cocoa crop in PNG if not correctly managed and controlled.

The next chapter describes the methods adopted in this study to investigate household livelihoods and cocoa production strategies in ENB Province.

Chapter 2

In the Field

This chapter describes the research methods employed in the study. The research approach relied on quantitative and qualitative methods, particularly qualitative methods associated with participatory action research (see Denzin & Lincoln, 2000; Chambers, 2002). By applying participatory approaches to smallholder research, with a focus at the household level, we aimed to make recommendations for improving smallholder productivity and incomes that supported existing livelihood strategies, reflected the needs and priorities of smallholders and hence had a higher probability of being successful. Further, the farmer-oriented approach of the research, whereby considerable time was spent with farmers and their families and agricultural extension officers were involved in the research design and data collection, encouraged a more ‘bottom-up’ methodology that facilitated an understanding of the socio-cultural context of smallholder cocoa production.

The research commenced with a review of the smallholder literature in ENB. This was followed by a half-day workshop in July 2003 with cocoa extension officers employed by the Cocoa and Coconut Extension Agency (CCEA)¹. The workshop sought to identify the main constraints on smallholder production as seen by the extension officers. The following broad topics were discussed:

- socio-economic characteristics of high and low cocoa producers and their families;
- agronomic and farm management practices of high and low cocoa producers and their families;
- factors influencing the supply of family and hired labour for cash crop production;
- influence of customary and social/religious factors on cash crop production;
- influence of land access and land tenure on cash crop production;
- effects of prices on smallholder productivity;
- role of market access on production; and,
- growers’ access to extension services.

Based on the results of the workshop a list of key factors affecting production was compiled to guide smallholder interviews and quantitative surveys (Table 2.1).

Table 2.1. Factors identified by extension officers as affecting smallholder production on the Gazelle Peninsula.

Agronomic and Farm Management Practices	Levels of block maintenance. Harvesting rates. Disease management. Wet or dry bean seller.
Household Labour	Household labour supply (demographic characteristics). Access to household labour (constraining factors). Household labour strategies in cocoa production.
Household Cocoa Holdings	Type of planting material. Type of land tenure. Methods of regulating family members' individual access to cocoa holdings. Size and location of cocoa holdings.
Household Resources	Access to: Adequate and secure land holdings. Labour from the extended family. Hired labour. Fermentary and dryer. Extension advice and services. Credit.
Household Social Relations	Levels of household conflict/stability. Income distribution amongst family members.
Household Livelihood Strategies	Range of livelihood options including off-farm employment and migration. Degree of economic pressure to harvest cocoa (e.g., school fees). Importance of cocoa to the household economy. Social and community obligations.

As evident in Table 2.1, the household has been emphasised as the unit of analysis, with attention paid to the range of economic and social activities that households pursue in addition to cocoa production. This has been done to place commodity production in the broader context of household livelihood strategies. Although household-level analysis has been highlighted, consideration has also been given to external factors, such as the role of extension, market access, cocoa prices and marketing as these affect household decision-making.

Study Sites

Data were collected from villages in two LLG areas in the northeast of the Gazelle Peninsula (Fig 2.1).

1. Malakuna No. 4, Ulautava and Tinganavudu villages in the Kokopo-Vunamami LLG area;
2. Vunalaing Village in the Livuan-Reimbar LLG area.

Malakuna No. 4, Ulautava and Tinganavudu villages all have good road access, are close to markets at Kokopo, and have been producing cocoa and copra since the early 1970s. Cocoa is cultivated under a mix of land tenure regimes including customary land tenure, 'purchase' and 'reserve' land (for further discussion see Chapter 4). The population of the council ward areas of Malakuna No. 4, Ulautava and Tinganavudu is 2,569 (National Statistical Office, 2001).

At Vunalaing Village, the hamlets of Tabaule and Bulupa were selected because unlike the Kokopo-Vunamami LLG villages, these hamlets do not have copra and rely primarily on cocoa for income. Also, land at Tabaule and Bulupa is under freehold title, gained when the land and title which was previously under plantation² and registered as State 'reserve' land was transferred to the landholding clan leader and subsequently subdivided amongst clan members. The majority of smallholders allocated blocks at Tabaule and Bulupa were from Vunalaing and Vunapaka villages. Villagers refer to this subdivided land where they have settled and planted cocoa as 'reserve land'. As 'reserve land', villagers claim the land is not subject to the same matrilineal inheritance rules as customary land and therefore is free from matrilineal claims from the wider clan group (see Chapter 4 for further discussion of 'reserve' land). The 'reserve' land tenure regime of Tabaule and Bulupa hamlets enables comparisons to be made with the Kokopo-Vunamami LLG villages where 37.2% of the cocoa is planted on customary land. Also, because Tabaule and Bulupa are close to the Cocoa Coconut Institute (CCI) (approximately 5 km away) the hamlets provide an opportunity to assess the effectiveness of CCI research and extension, especially since Tabaule and Bulupa have only recently planted cocoa in the last ten to fifteen years. In the 2000 National Census, the population of Vunalaing Council Ward was 927.

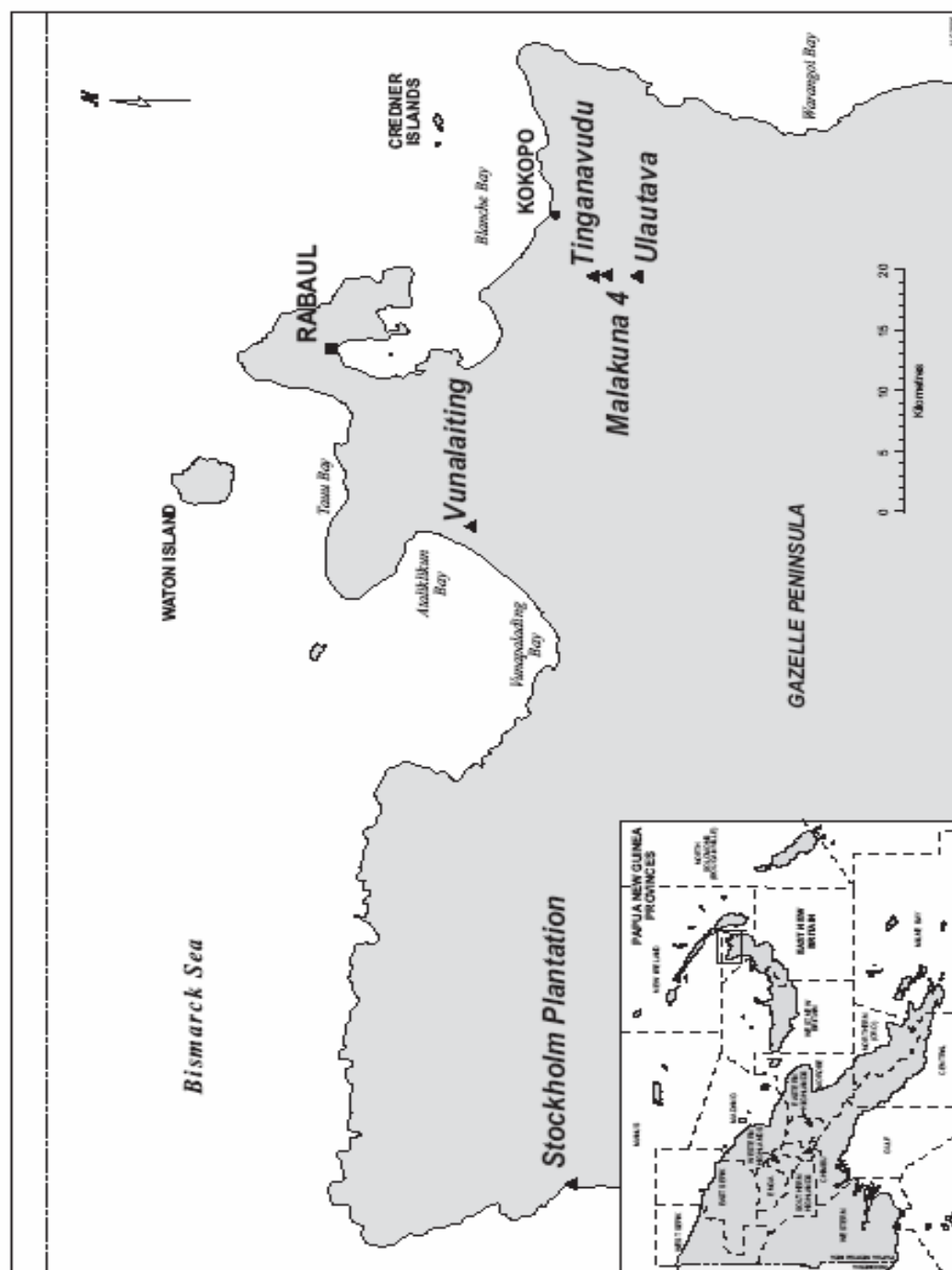


Fig. 2.1. Field sites in East New Britain Province.

The study area of the Gazelle Peninsula has a rainfall of approximately 2,000 mm per annum along the Blanche Bay coast, rising to 2,700 mm in the western area near the Keravat River, with the drier months between May and October (Ghodake *et al.*, 1995). The seasonal cocoa flush periods differ between the two LLG study areas. In the Kokopo-Vunamami LLG villages the main cocoa flush is from April to June/July, with a ‘mini’ flush in November-December. Moving to the north-west of the survey area to the Livuan-Reimbar LLG area, villagers identify a main cocoa flush period running from September/October to December/January, with a ‘mini’ flush in May/June to July.

Data Collection

Data collection in Kokopo-Vunamami LLG and Livuan-Reimbar LLG villages was in three parts:

- Weekly interviews and surveys of fourteen smallholder households.
- Socio-economic survey of 93 cocoa smallholder households.
- Cocoa farm management assessment (including an assessment of pest and disease levels) of 100 smallholder cocoa blocks in the Livuan-Reimbar LLG.

Weekly Household Interviews

Weekly household interviews form the bulk of the data underpinning this study. For this report a household is defined as all those members of the family and extended family residing together in the same or nearby houses, and sharing household resources. Typically, meals are shared between household members even though members may live in adjacent houses.

Weekly interviews were undertaken during three phases. The first phase was for a four-week period in October-November, 2003. A second phase ran for four weeks in May 2004. In addition a small number of interviews were undertaken between May and November, 2004 by the research assistants during brief monitoring visits to the field sites. A third and final round of interviews was conducted among Vunalaing Council Ward villages in December 2004 and January 2005 over a five week period.

The second and third phases of the weekly surveys were timed to coincide with the main cocoa flush periods of the two LLG areas. During the 2004 survey period, however, the May to July flush was reduced substantially because of unusually wet conditions in the lead up to the flush period which affected flower and fruit formation (see also *Post Courier*, 19 August, 2004). Many respondents complained about the rain affecting production and the high

infestation rates of *Phytophthora* infected pods (Black Pod) in their blocks. It is likely that for some growers, especially dry bean sellers, cocoa incomes for the 2004 flush period were significantly lower than usual for this period. Similarly, in the 2004 October/November to December/January flush in the Livuan-Reimbar LLG area, villagers commented that the flush began well, but pod development declined slightly after a few weeks. Thus, the intention to capture seasonal variations in household cocoa production, economic activities and labour allocation was only partly met.

Households were selected on a range of characteristics including demographic profile of household, size of cocoa holdings and whether the household was predominantly selling wet or dry cocoa beans. The sample size for the weekly repeat interviews was small because of the lengthy time required to collect detailed qualitative data to develop household case studies.

During the weekly surveys, each family was interviewed on the same day each week. Each interview took between one and two hours to complete, allowing for three families to be interviewed per day. By having sample households spatially clustered in two main areas, travel times between interview locations were reduced. This is especially important when household members may be absent on a particular interview day (e.g., visiting relatives, hospital, business in town). Further, a spatial clustering of sample households allows the influence of village-level factors affecting cocoa production to be determined, such as village-wide preparations for church, school or ceremonial activities which may reduce or enhance the supply of labour for cocoa production.

Each week a standardised survey instrument was administered which recorded for the previous seven days (the period between interviews):

- Quantity of cocoa/copra sold.
- Income earned from cocoa.
- Income from other sources (e.g., wage labour, copra, vanilla and sales of items at local markets and remittances from town-based relatives).
- Household and non-household labour contributions to cocoa or copra production.
- Cocoa block maintenance activities (labour contributions and type of work).
- Household contributions to communal activities like council or church group work days.

The purpose of these surveys was to develop household case studies that determined the importance of cocoa in terms of labour and income, as well as revealing how households organised and mobilised labour for cocoa production and other livelihood activities.

An informal interview typically followed the standardised survey instrument and expanded on points raised in the formal interview (e.g., labour constraints, theft of cocoa pods or vanilla beans and plants, transport difficulties, and cocoa disease problems). Interviews explored decision-making concerning the allocation of household labour and income, broader factors influencing household and family members' participation in cocoa production, and other household and village activities. Informal interviews were 'free-flowing' and gave smallholders an opportunity to raise points which they saw as important in cocoa production or in other aspects of their lives more generally. On most occasions the survey and interview format involved interviewing husband and wife separately. This was especially important when one partner, usually the wife, had a tendency to take a 'back seat' during interviews. By ensuring women were included in the interviews, the study captured the important role of women in cocoa production and their views on commodity production and broader household and community issues.

In phases one and two, an extension officer was usually present at the weekly interviews. This served two purposes. First, it involved extension officers directly in the research and helped them to develop an appreciation of the broader socio-economic factors influencing smallholder cocoa production. Secondly, when required, they provided advice regarding particular problems affecting smallholders' blocks (e.g., methods of pest control). Discussions with the extension officers when travelling between interviews also helped the research team develop a fuller understanding of each smallholder family and their circumstances. Often extension officers picked up important details that would have gone unnoticed by other research team members. For instance, the extension officers often made an informal block inspection of the interviewee's cocoa holdings while the rest of the team was engaged in interviews. These inspections enabled a rapid assessment of the condition of the block and the identification of any particular management problems.

Socio-economic Surveys

The smallholder sample (n=93) for the socio-economic survey was drawn from the same villages selected for the weekly surveys. The survey was carried out in November-December, 2003. Data were collected on the following:

- Planting details (cocoa variety, area and year planted, type of shade, land tenure arrangements).
- Cocoa harvested in preceding seven days (amount harvested, income earned, costs of production).
- Household demographic characteristics.
- Farm and non-farm income sources.
- Farmer training and extension received.
- Ownership of farm tools.

Households were randomly selected from the two LLG villages and the surveys were carried out by CCI research staff and four second-year Vudal University students. The students participated in a training workshop which outlined the purpose of the survey and explained interviewing techniques. The questionnaire was piloted by the students among eight growers prior to the main survey being administered. The pilot survey resulted in some minor changes to the survey instrument and gave students an opportunity to practice and refine their interviewing techniques. Throughout the survey students were closely supervised by CCI research staff and/or extension officers.

Cocoa Farm Management Assessments

In November and December, 2004, an assessment of smallholder cocoa farm management was conducted on 100 smallholder cocoa holdings belonging to randomly selected cocoa farmers in the Livuan-Reimbar LLG. The assessment coincided with the flush period in the north-west of the Gazelle Peninsula. For each cocoa holding, the farm management assessment recorded:

- Terrain and size of holding.
- Main varieties of cocoa present and year planted.
- Shade trees present.
- Numbers of un-harvested dry pods.
- Numbers of healthy pods.
- Numbers and types of diseased pods.
- Presence of Canker, Vascular Streak Disease, Pink Disease, Longicorn and Webworm (*Panseptor*).
- Weed and shade control standards.
- Pruning standards and block sanitation levels.

For the count of cocoa trees affected by disease and the number of un-harvested pods, 10 cocoa trees per block were surveyed (in total 1,000 trees). On each tree, counts were made of the number of: *Phytophthora* infected pods (Black Pod); dry pods (cocoa pods that were not harvested when ripe); and, healthy full size pods. The first tree surveyed on each block was on the road-side edge of the block and then every fifth tree, moving into the centre of the block was surveyed. Pest and disease assessment was supervised by a staff member of CCI's pathology section, with assistance from a senior extension officer. Data collection was undertaken by research staff within CCI's economics section and three Vudal University students on work experience with the project.

Industry Interviews

Industry stakeholder interviews included the following people:

- Members of the Board of Directors of the Bailu Plantation landowner group at Malakuna No. 4, Ulautava and Tinganavudu villages.
- CCI extension officers and senior managers.
- Commercial sector representatives (including plantation managers and cocoa exporters).
- Rural Development Bank personnel.
- Executive Director of the Cocoa Growers Association.
- Provincial government representatives from Division of Primary Industry (DPI), Lands Division and Planning Division.

In many of the meetings and interviews with industry stakeholders the research team discussed ideas for the design and implementation of alternative models of extension and marketing for cocoa production. The interviews also provided information about new and proposed industry policies and interventions, the current state of the industry and the broader national and provincial policy and institutional context of smallholder production. The interviews were very informative and revealed some of the constraints on smallholder production, especially those factors external to the household such as price, government policies, transport, extension services, credit facilities and general industry support and marketing.

Chapter 3

Smallholder Cocoa Production in East New Britain

Cocoa production plays a primary role in the rural economy of ENB and is the main income source for many rural households (Yarbro & Noble, 1989; Ghodake *et al.*, 1995; Omuru *et al.*, 2001). Over the last decade smallholder cocoa production in ENB has been variable (Figure 3.1), but has increased its share of total production relative to plantation production (Figure 3.2). From 1994/95 to 2002/03 total annual smallholder production averaged 13,130 tonnes compared with total plantation average annual production of 3,644 tonnes (Cocoa Board of PNG data). Further, between 1994/95 and 2002/03 approximately 54% of national cocoa production by smallholders was from ENB (Cocoa Board of Papua New Guinea data). More recently, production of cocoa in Bougainville has rebounded with the end of civil conflict and Bougainville is likely to overtake ENB as the largest provincial producer in PNG in the near future.

The dominance of ENB, and in particular the Gazelle Peninsula, in national production is partly an historical legacy of intensive post-Second World War government efforts to establish indigenous cocoa production in the province. In the 1950s and 1960s, several projects such as the large agricultural land settlement schemes at Vudal and Warangoi, the Tolai Cocoa Project and the founding of the Lowlands Agricultural and Experiment Station (LAES) at Keravat facilitated the uptake of cocoa as a smallholder commodity crop.

Recent data on household average annual cocoa incomes for ENB are limited. Omuru *et al.* (2001) estimated average annual cocoa income per household of K2,867, made up of dry bean sales of K2,803 and K64 for wet bean sales. Their study estimated an annual income of K2,371 for dry bean sellers and K408 for wet bean sellers. Later, Omuru (2005) noted in ENB that gross margins for cocoa smallholders selling dry bean were 69.4% higher than for those selling wet bean.

Like cocoa growers in other provinces in PNG, most ENB growers sell their cocoa as wet bean (Yarbro & Noble, 1989; Ghodake *et al.*, 1995). That most ENB cocoa growers are wet bean sellers indicates that overall cocoa income and returns to labour are relatively low. The low economic return from the sale of wet bean has implications for levels of farm investment, farm management practices including household labour strategies, the use of hired labour and the appropriateness of current extension strategies. (See also Chapters 6 and 8).

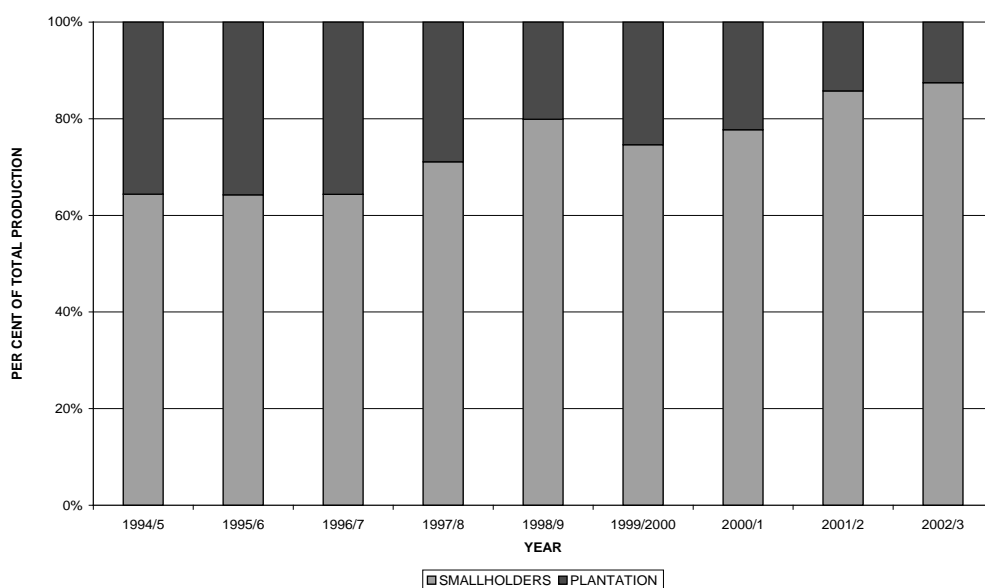


Figure 3.1. Smallholder production as a percentage of total production for ENB, 1994/95–2002/03.

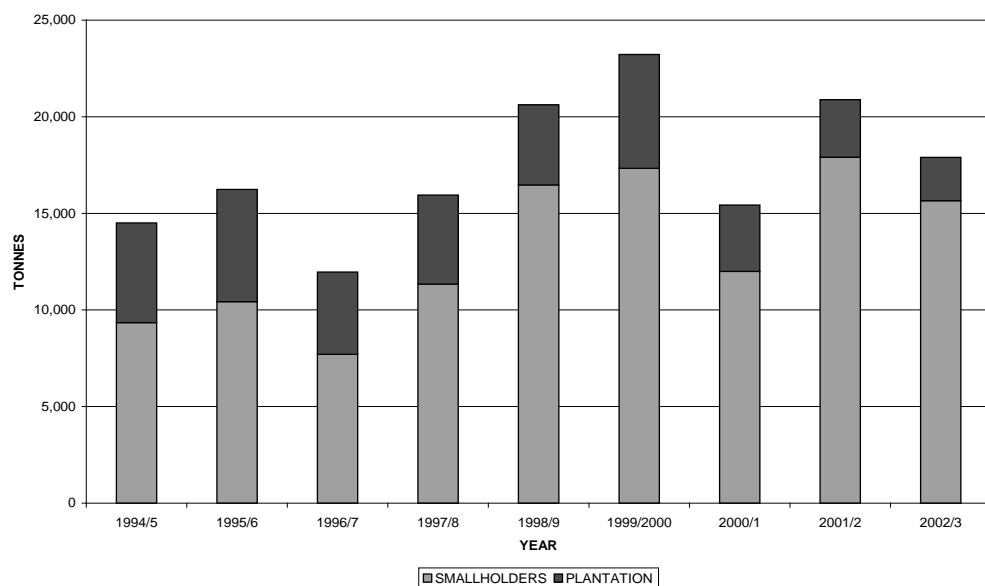


Figure 3.2. Total production by smallholders and plantation in ENB, 1994/95–2002/03.

Despite large fluctuations in smallholder output (Figure 3.2), yields per hectare have been rising since the late 1980s (Table 3.1) due to the introduction of high yielding and more disease-resistant hybrid cocoa varieties. New cocoa hybrid planting materials, SG1 and SG2, were released in 1982 and 1986 respectively, and these were followed by SG2 Modified hybrid planting materials (Big and Small) in 1994 and two polyclonal hybrid cocoa clones in 2003 (Yinil *et al.*, 2006).

Based on 1999 data, Omuru (2001) reported smallholder yields of 620 kg/ha, a substantial increase on previous yield estimates in ENB, most of which were in the range 250 kg/ha to 400 kg/ha (Table 3.1). The improved yields recorded by Omuru (2001) were explained by: a) more favourable climatic conditions leading up to the survey; b) the large number of high yielding hybrid cocoa trees planted after the 1994 volcanic eruption in Rabaul coming into production at that time; and c) high cocoa prices which motivated smallholders to harvest their cocoa blocks.

Table 3.1. Smallholder yields for ENB from 1968-1999.

Year (author)	Smallholder yields for ENB kg/ha	Dominant cocoa variety	Study location
1970 (Salisbury)	290	Trinitario	Gazelle Peninsula
1974 (Godyn)	290	Trinitario	Gazelle Peninsula
1987 (ADB)	250	No data	Gazelle Peninsula
1989 (Yarbro & Noble)	320	Most SG1	ENB
1989 (Nicholls)	320	85% SG1	Kokopo
1989 (Nicholls)	360	85% SG1	North Coast
1994 (George)	350	No data	Gazelle Peninsula
1998 (Omuru <i>et al.</i> 2001)	401	Most SG2 Modified	ENB
1999 (Omuru, 2001)	620	Most SG2 Modified	ENB

Variability in smallholder productivity in ENB has received little attention in the literature. Omuru *et al.* (2001) and Yarbro & Noble (1989) reported a weak positive relationship between cocoa yields and area planted. Yarbro & Noble (1989) found reported higher yields were associated with larger planted areas, whilst Omuru *et al.* (2001) found that although the highest yields were recorded amongst the largest farm size group (>6 ha), the second highest yields were among the smallest farms (1 ha).

Studies of smallholder yields in ENB have consistently reported yields below those of the plantation sector. Further, despite the recently reported increase in smallholder yields in ENB, yields remain well below the potential levels of the higher yielding SG2 cocoa hybrids released to smallholders. Yet, the productivity of ENB smallholders is higher than that of cocoa smallholders in other provinces (Nicholls, 1989), which may be explained by their greater uptake rate of hybrid cocoa varieties because of their proximity to the cocoa breeding centre and nursery at the national Cocoa Coconut Institute at Tavilo.

Smallholder Studies in ENB

Although the number and scope of studies investigating the constraints on smallholder cocoa productivity on the Gazelle Peninsula and elsewhere in PNG is limited, several common factors have been identified to explain low productivity. These include:

- Labour shortages.
- Low levels of block maintenance (and high rates of pests and diseases).
- Land shortages.
- Low cocoa prices.

Each is discussed briefly.

Labour Shortages

Most smallholder households rely on unpaid family labour for cocoa production (Yarbro & Noble, 1989; Omuru & Fleming, 2001). Despite the large size of ENB families, labour shortages are a major constraint on cocoa output (Ghodake *et al.*, 1995; Lummani & Nailina, 2001). According to Lummani & Nailina (2001), labour shortages result from:

- Lack of cooperation amongst household members in cocoa production.
- Illness or death of family members (disruptions to work schedules during mourning periods).
- Reduced access to labour from the extended family.
- Increase in the size of cocoa holdings (insufficient family labour relative to area of cocoa planted).
- Rising cost of hired labour.

The high mobility of family members, mostly male, was also a factor affecting access to household labour. Much village out-migration was related to education and marriage. Other reasons included recreational activities and visits to relatives living elsewhere (Lummani & Nailina, 2001).

The use of hired labour to overcome household labour shortages is limited and sporadic. Omuru *et al.* (2001) reported 37% of sample households employed hired labour during their 12 month survey period, mostly for cocoa harvesting tasks. Ghodake *et al.* (1995), on the other hand, found that the use of hired labour was most often restricted to large laborious tasks such as establishing and rehabilitating cocoa, and not for harvesting. Whilst some smallholders employ hired labour to overcome household labour shortages, they appear to be sensitive to changes in the wage rates for hired labour (Omuru & Fleming, 2001).

Low Levels of Block Maintenance

Ghodake *et al.* (1995) identified poor farm management practices as a major constraint on cocoa production, which may be related to the labour constraints discussed above. Weeds, pests and disease control and cocoa and shade pruning were highly variable among cocoa growers, and amongst cocoa blocks belonging to individual growers. Mature cocoa blocks were “very often grossly overshadowed” by *Gliricidia* shade trees (1995, p.106), and had “high levels” of pest infestations (1995, p.105). Pest infestations were present on 40% of surveyed cocoa blocks, and “on most farms cocoa suffered from substantial economic losses” due to insect damage (1995, p.107). Rarely were the recommended chemicals or other control measures applied to manage cocoa pests and diseases, and even on moderately well-managed blocks, management practices were either incorrect or inadequate.

Other smallholder cocoa studies conducted on the Gazelle Peninsula have similarly reported inadequate weeding, pruning, shade control and pest and disease control (e.g., Nicholls, 1989; Yarbrow & Noble, 1989; George, 1994; Omuru *et al.*, 2001). In a sample of 100 farmers in ENB, Omuru *et al.* (2001) found that 82% and 73% of farmers identified cocoa pests and cocoa diseases respectively as the most important factors limiting cocoa production. The same study reported the ratio of diseased to healthy pods on five randomly selected cocoa trees within a 20 m radius of each other on each cocoa holding. Disease rates varied across ten field sites, with an average of 17.3% of total pods per tree affected by Black Pod (Omuru *et al.*, 2001).

Several factors contributed to poor management levels, including low cocoa prices, labour shortages and inadequate knowledge of proper management practices. It is possible that the effects of inadequate levels of maintenance of cocoa blocks have been exacerbated by some of the new hybrid cocoa varieties that require high levels of management inputs (e.g., weeding, shade control, and pruning — see Chapter 7).

Land Shortages

Several studies conducted in ENB and the Gazelle Peninsula note land shortages as constraints on expanding cocoa production in the province (e.g., Granger, 1971; Godyn, 1974; Fenbury, 1978; Ghodake *et al.*, 1995; Lummani & Nailina, 2001; Lowe, 2006). Whilst many of these same studies, spanning 30 years, also provide data on average size of cocoa holding per household, identifying a trend in the average size of cocoa holdings is difficult because land availability is highly variable across council wards in ENB and the Gazelle Peninsula, and also within and between village clans and extended families. Moreover, none of the above studies provides detailed analysis of the various ways in which land shortages affect production beyond limiting the area for cocoa expansion.

As Epstein (1969) noted in the 1960s, as well as others since then (e.g., Salisbury, 1970; Nicholls, 1989; Ghodake *et al.*, 1995; Lowe, 2006), various strategies have been employed by smallholders to overcome land constraints to secure land for cocoa. Such strategies have included: a shift away from matrilineal and communal land tenure to more patrilineal and individual tenure systems; reassessment of traditional land-use categories, the ‘purchase’ of customary land; and the acquisition of government-leased land on the agricultural land settlement schemes in ENB and West New Britain. For example, Ghodake *et al.* (1995) noted 58% of cocoa blocks and over 60% of food gardens were located on ‘purchased’ land (see Chapter 4 for further discussion of ‘purchased’ land)¹.

To date, research has not examined the influence of land shortages or the types of tenure (e.g., ‘purchase’, leasehold or customary land) on smallholder productivity, farm size, farm management and investment practices. To do so would be a difficult and complex exercise. In the study by Ghodake *et al.* (1995), smallholders identified land shortages as the major constraint on agricultural production, and for many smallholders, ‘purchasing’ land was their only way to increase production. They noted that some cocoa farmers were reluctant to plant cocoa on customary land because of potential uncertainty

about their tenure rights in the future. When tenure rights to cocoa planted on customary land are disputed, investment in, and maintenance of, the cocoa block typically ceases. This does not necessarily mean that planting cocoa on ‘purchased’ land will lead to increased cocoa production. As Ghodake *et al.* (1995) found, some smallholders were ‘purchasing’ land to plant cocoa, not to overcome present land constraints, but rather to secure land for their children’s needs in the future. The productivity of cocoa stands on such ‘purchased’ land may therefore be very low.

Cocoa Prices

Most smallholder studies conducted on the Gazelle Peninsula have noted the influence of cocoa prices on smallholder production (e.g., Godyn, 1974; George, 1994; Ghodake *et al.*, 1995; Omuru *et al.*, 2001). Papua New Guinean commodity crop producers are considered to be price sensitive (i.e., smallholder production levels tend to be positively correlated with price). However, price interacts with production in several ways. Omuru *et al.* (2001) found that 85% of surveyed cocoa farmers in ENB said they would increase plantings of cocoa if prices were higher. Other studies on the Gazelle Peninsula report that cocoa maintenance levels and farm investment levels appear to decline with falling prices (e.g., Godyn, 1974; Moxon, 1983 cited in Ghodake *et al.*, 1995). During times of depressed prices, smallholders are also more likely to search for alternative farm and non-farm income sources (Godyn, 1974). However, Ghodake *et al.* (1995) also note that poor block management was evident during times of “very high” world prices (1995, p.124). The impact of low cocoa prices on access to family or hired labour for cocoa production has not been adequately explored.

Present Study

In the present study smallholders were asked to identify the four main constraints on cocoa production. The top four, in declining order of importance were:

- theft of cocoa pods (in some cases, an indication of under-harvesting) (27%);
- poor block condition (overgrown cocoa trees, over-shading and high levels of pests and diseases) (26%);
- labour shortages (19%);
- limited knowledge of proper block management practices (especially regarding the new hybrid cocoa clones) (9%).

Relatively high wet bean prices during the survey period meant that theft was most often identified by smallholders as a constraint on production, with ‘poor block condition’ ranked a close second. Theft undermines smallholder motivation in a similar way to poor block condition. When the most accessible and easily harvested pods are stolen only the pods that are more difficult to harvest remain, so more labour is required to harvest each kilogram of wet bean.

Extension officers identified a similar set of constraints on smallholder production (apart from pod theft which only smallholders identified) during a workshop on smallholder production on the Gazelle Peninsula (Table 2.1). The similarities in the constraints on production identified by smallholders and extension officers in the present study and those outlined above in earlier studies on the Gazelle Peninsula (in particular labour shortages and low levels of block maintenance), point to a set of problems that have been known for a long time by the industry.

The following four chapters explore the underlying socio-economic factors that make these on-going problems difficult to resolve using conventional extension strategies. The next chapter begins with a review of cocoa holdings and discusses how aspects of land tenure interact with smallholder production.

Chapter 4

Smallholder Cocoa Holdings and Land Tenure

This chapter presents an overview of smallholder cocoa holdings in terms of size and land tenure regimes in the two survey LLG areas of Kokopo-Vunamami and Livuan-Reimbar to provide a background to the discussion in the following chapters of how household livelihood strategies interact with cocoa production to influence productivity. It provides insights into how tenure regimes are changing in the study area in response to land shortages and how these changes are affecting cocoa production.

Cocoa Holdings

There is great variation in the characteristics of the cocoa holdings among smallholders in the two LLG areas (Table 4.1). Time and logistical constraints meant that it was not possible to physically survey smallholder blocks to ascertain the size of holdings. Instead, smallholders were asked how many cocoa trees they owned in each block and these numbers were used to calculate the area planted to cocoa by each household. Average size of cocoa holding among survey households was 4.8 ha for Kokopo-Vunamami and 1.7 ha for Livuan-Reimbar LLG areas. These data are compared with data from other smallholder studies in ENB in Table 4.2.

Apart from Godyn's 1.8 ha average household size of cocoa holdings reported in 1974, all later studies, with the exception of the Livuan-Reimbar LLG data, have noted relatively large average cocoa holdings per household. These holdings are considered large given the labour required to adequately maintain a management-intensive crop such as cocoa. Ghodake *et al.* (1995, p.125) suggest that "one full-time labour unit per 3 hectares is required to implement an effective cocoa management package". Similarly, G. McNally (NGIP-Newmark, pers. comm., 2005) estimates one full-time labour unit per 2.5 hectares is required for cocoa to be fully harvested and maintained efficiently. Amongst the study households in the Kokopo-Vunamami LLG and Livuan-Reimbar LLG villages, average household sizes were 6 and 5.2 respectively, with 61% of sample households with children in the school-age range of 5-14, most of whom were attending school¹. In addition, some older children and young adults were attending high school or vocational college². However, despite relatively high rates of school attendance, there appears to be sufficient household labour to maintain cocoa production, especially at Livuan-Reimbar

Table 4.1. Some characteristics of smallholder cocoa holdings.

Cocoa Holdings	Kokopo-Vunamami LLG	Livuan-Reimbar LLG	Combined
Median area of cocoa per household (ha)*	4.8 ha	1.7 ha	3.25 ha
Mean number of cocoa blocks per HH	3.2	2.4	2.8
Two most common varieties of cocoa	SG2 (64%) SG2 Modified (14%)	SG2 (55%) SG2 Modified (24%)	SG2 (59.5%) SG2 Modified (19%)
Mean year of planting	1991	1995	1992
Per cent of growers who increased area under production in last 5 years	35%	43%	39%
Per cent of growers whose areas under production contracted in last 5 years	27%	11%	20%
Per cent of growers whose area under production remained unchanged in last 5 years	37%	43%	40%
Per cent of cocoa blocks planted under coconuts	91%	12%	58%
Per cent of growers owning or part-owning a fermentary and dryer**	52%	48%	50%
Most common form of land tenure for cocoa holdings	Customary tenure (37%)	Customary tenure (64%)	Customary tenure (50.5%)

Data based on socio-economic survey.

* Reasonably accurate data on area under cocoa cultivation were obtained from 53 smallholders.

** The higher than expected figure for fermentary ownership is due to smallholders being asked about ownership/part ownership rather than if they were the registered operator of a fermentary. Part-ownership in fermentaries is common. Also, it is likely people mentioned fermentaries that are no longer working, and/or fermentaries that they may not be used regularly because they do not have sufficient quantities of cocoa for drying, or as a part-owner, they have restricted access to its use. Hence the figures do not reflect the number of operating fermentaries registered but rather gives an indication of people's access to fermentaries.

Table 4.2. Average area of smallholder cocoa holdings for ENB from 1968-2007.

Year/authors	Average area of cocoa holdings per household	Study location
1974 (Godyn)	1.8 ha	Gazelle Peninsula
1989 (Yarbro & Noble)	5.4 ha	ENB
1995 (Ghodake <i>et al.</i>)	5.0 ha*	Gazelle Peninsula
2001 (Omuru <i>et al.</i>)	3.15/2.63 ha**	ENB
2007 Present study	4.8 ha	Gazelle Peninsula (Kokopo-Vunamami LLG)
2007 Present study	1.7 ha	Gazelle Peninsula (Livuan-Reimbar LLG)

* Size of household cocoa holdings varied from 0.2 to 30 ha. No figure for median size of household cocoa holdings provided.

** 2.63 ha is the estimated average area planted to cocoa taking into account cocoa trees that have died and not been replanted (Omuru *et al.*, 2001).

LLG villages where the median size of cocoa holding is 1.7 ha (Table 4.1). That smallholder productivity is so low suggests that other factors are working to constrain the supply of household labour for cocoa production (see Chapter 5).

Although the present study did not find a correlation between household size and area of cocoa holding, there was a strong positive correlation between the size of cocoa holdings and the age of growers (Figure 4.1).

It is likely that many elderly growers have allocated some of their holdings to their sons or permit their adult sons access to harvest their cocoa holdings, and therefore hold the cocoa only in name. However, the larger size of cocoa holdings controlled by older growers has implications for block maintenance, replanting and investments in farm inputs. Most elderly growers visited as part of the weekly surveys and interviewed for the socio-economic survey (Chapter 2) could be described as ‘retired’ or ‘semi retired’ because they were no longer actively participating in cocoa production. Typically, they gave away harvest rounds and/or relied on their sons, nephews, adoptees or grandchildren to harvest or weed the cocoa block. For some of these elderly or senior household heads, the motivation to maintain their control over cocoa production has two elements: 1) the social prestige and status that comes from being able to allocate harvest rounds to relatives or to donate harvests to the church; and 2) maintaining production within the household for as long as possible so that tenure rights to the cocoa block are not transferred too early to their sisters’ sons under matrilineal inheritance principles governing customary land.

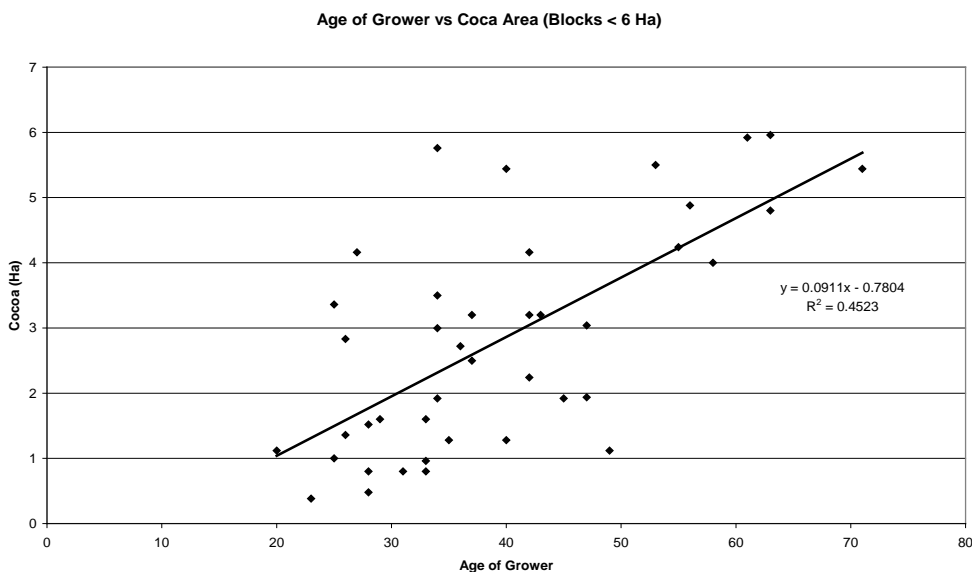


Figure 4.1. Age of grower and size of cocoa holdings, Gazelle Peninsula.

Cocoa varieties cultivated by respondents ranged from early plantings of *Trinitario* (known locally as German cocoa) through to cocoa hybrids (SG2) released in the mid 1990s. The most common varieties of cocoa held by smallholders were SG2, followed by SG2 Modified (Table 4.1). The high yielding hybrid clones that were released officially in 2003 were not found among sample households, although some planting had been undertaken by a small number of growers in the LLG areas sampled.

Most cocoa (91%) in Kokopo-Vunamami LLG is planted under coconuts, (Table 4.1) and many smallholders plant additional shade trees such as marmar, *Gliricidia*, bananas, fruit trees and betel nut. In the Livuan-Reimbar LLG where pest damage to coconuts is a major constraint on coconut cultivation, only 12% of cocoa is planted under coconut: *Gliricidia* is the most common shade tree. *Gliricidia*, unlike coconut shade, requires regular pruning to prevent excessive shading of cocoa. Further discussion of shade control practices is provided in Chapter 7.

Cocoa plantings have been increasing in both study sites over the last five years. In the Livuan-Reimbar LLG 43% of sample households claimed they had expanded their cocoa holdings, compared with 35% of households in the Kokopo-Vunamami LLG villages (Table 4.1). The larger proportion of

smallholders in the Livuan-Reimbar LLG who expanded their cocoa holdings reflects the recent settlement and planting of smallholder cocoa on Tabuale and Bulupa lands. For some smallholders their cocoa holdings had decreased in size (Table 4.1). The two most common factors cited by smallholders for the contraction of their cocoa holdings were labour shortages (15%) and tree mortality due to pests, diseases and poor block condition (15%) (see Chapter 7 for further discussion).

Cocoa Land Tenure

Smallholder cash crop production, management and investment decisions may be influenced by the type of land tenure regime governing cocoa blocks. In the survey areas, cocoa is planted on land governed by four main types of land tenure arrangements. These include:

1. Customary tenure.
2. 'Reserve' Land.
3. 'Purchase' Land.
4. State Agricultural Leasehold Land.

Customary land tenure remains the most common form of tenure for cocoa production in the northeast Gazelle, although as shown in Table 4.3 there are considerable differences between the two study sites in the proportions of cocoa blocks under different land tenure arrangements.

Table 4.3. Cocoa holdings by land tenure type*.

LLG Study Location	Customary Tenure (%)	Reserve Land (%)	Purchase Land (%)	Leasehold Land (%)	Land belonging to another person** (%)	Total (%)
Kokopo-Vunamami	37	32	23	7	1	100
Livuan-Reimbar	64	15	14	6	1	100

* See text for definitions of land tenure types.

** Temporary access.

Customary Land

Customary land is defined as land that has remained under the control of the clan (*vunatarai*) and has not been alienated by the State or held under private or mission control for plantations or other land uses. Customary land on the Gazelle Peninsula is generally governed by matrilineal inheritance principles. A family may plant, harvest and manage cocoa planted on matrilineal land belonging to the male household head (father), if alive, or the female household head (mother). Cocoa planted on matrilineal customary land is typically inherited by a man's sisters' children, and not his own children. His own children have land tenure rights in the natal clan of his wife, that is, their mother's clan. In practice deviations from this matrilineal ideal are common, even as early as the 1950s (see Epstein, 1969; Salisbury, 1970; Lowe, 2006), and matrilineal inheritance rules are not always straightforward. Claims on cocoa blocks may be exercised by individuals (especially children) who have invested considerable time and labour in the cocoa block. Typically, these claims and disputes over cocoa planted on customary land arise following the death of the father. For example, there are instances of children of the deceased seeking valuations of their cocoa blocks in order to claim compensation from their father's clan for their labour and assets invested in the block (W. Mapua, CCI, pers. comm., 2005).

Among surveyed smallholders in the Kokopo-Vunamami and Livuan-Reimbar LLG areas, 37% and 64% of cocoa blocks respectively, were planted on customary land. The relatively small proportion of cocoa blocks planted on customary land by smallholders in the Kokopo-Vunamami LLG villages reflects in part the long history of contact with colonial administrators and traders during which time land was alienated from customary ownership (see below for further discussion). Another important reason for the relatively small number of cocoa blocks on customary land in Kokopo-Vunamami LLG villages is that more recently villagers have commenced 'selling' exclusive rights to customary land to other clan members. These 'purchases' of customary land are discussed below.

Reserve Land

When Tolai villagers refer to ‘reserve’ land they mean land under Freehold Title which previously was Freehold State Reserve Land, Native Reserve or Foreshore Reserve Land and which at some time during the late Nineteenth or Twentieth Century was land:

- Alienated from customary ownership by the German colonial or Australian government administrations, or purchased by the State.
- ‘Purchased’ or acquired by overseas traders, private plantation owners or Christian missions for plantations or other purposes.
- Granted as a gift to Christian missions and overseas traders. Early missions and some traders were given ‘access rights’ to land following a ‘gift’, such as food or shell money, which represented a token payment for user rights to the land (see also Salisbury, 1970).

Thirty-two per cent and fifteen per cent of smallholder cocoa in the Kokopo-Vunamami LLG and Livuan-Reimbar LLG villages respectively was planted on reserve land. Most reserve land in these LLG areas was previously Native Reserve land or land under privately owned copra/cocoa plantations. The larger proportion of cocoa planted on reserve land in the Kokopo-Vunamami LLG villages than in the Livuan-Reimbar villages, draws attention to how extensive land alienation was in the eastern portion of the peninsula. Some of the first land ‘sold’ by Ulautavia Village was to ‘Queen’ Emma Forsayth, a noteworthy American-Samoan trader (smallholder interview) in the Kokopo area in the late Nineteenth and early Twentieth Century. Rowley (1965 in Epstein, 1969 p.24) also noted that by 1914, approximately 39% of arable land on the Gazelle Peninsula had been alienated by the German administration. Some of the land that was alienated during the German colonial period was later subdivided into land parcels for State lease purposes, while the remaining land became State Reserve land for future purposes.

Following PNG’s political independence in 1975, the new government inherited the alienated land from the Australian administration. Portions of alienated State Reserve land were returned to customary landowners (W. Reven, Lands Office, Kokopo, pers. comm., 2005). Also, under the Australian administration’s plantation redistribution scheme of the early 1970s, the administration purchased plantations from foreigners and sold the land to individuals and customary landowning groups (Incorporated Landowner Groups). When the purchase was complete the land was converted to Freehold Title and returned to the customary landowning group (or individual)³. The objective of the government’s land reacquisition and redistribution scheme was

to pave the way for greater participation by Papua New Guineans in agricultural production (W. Reven, Lands Office, Kokopo, pers. comm., 2005).

Many landowning groups have succeeded in purchasing and gaining freehold title over the land through the scheme, but other groups have failed due to competing ownership claims on the land. In some cases, individuals and Incorporated Landowner Groups have raised funds from their communities and made payments for the return of the land, but to date, they are still awaiting a decision on the ownership of the land intended for purchase (M. Tabar, CCI, pers. comm., 2005).

Typically, land purchased from the government was subdivided among clan members, although the land subdivision by clan leaders sometimes provided an opportunity for non-clan members to gain access to the land⁴. According to villagers, the portion of subdivided land allocated to each clan member became their individual property for one generation to be inherited by a man's sons and daughters. Thus, 'reserve' land planted to cocoa can be passed onto smallholders' children, and it is free of matrilineal inheritance claims from the wider clan group.

Tabaule and Bulupa areas consist largely of 'reserve' and 'purchase' land. After independence in 1975 clan leaders from Vunalaing Village began negotiations with the Lands Department for the return of alienated land to the clan leaders on behalf of the customary landowners. In the early 1980s, when the 'reserve' land was returned to the claimants it was subdivided amongst members of the customary landowning group and a small portion of less desirable land (e.g., steep slopes) was sold to non-clan members (typically relatives or friends of clan leaders). Some Tabaule and Bulupa smallholders continue to maintain cocoa blocks in their home villages or in the villages of their wives where their sons will hold tenure rights in the future.

Purchase Land

'Purchase' land was previously customary land or returned alienated State Reserve land, sold to a clan or non-clan member. The purchase of land to plant cocoa and overcome land shortages has been occurring on the Gazelle Peninsula for at least several decades (Salisbury, 1970; Bourke, 1976; Ghodake *et al.*, 1995; Lowe, 2006). Ideally, sales of customary land must be approved by all clan members before the land is sold and transferred to freehold tenure by the Lands Office. The vendor and the purchaser sign a customary land sale agreement document (under the Land Tenure Conversion Act) which stipulates

that the vendor's rights, entitlements and interests on the purchased land are to be transferred to the purchaser. Under formal processes, the community has a period of one month after the announcement or advertisement of the sale to lodge an objection with the ward councillor before the sale agreement is signed by the LLG President and forwarded to the Lands Department for approval of the purchase and transfer of customary land to freehold tenure (Ereman Peril and Willian Peren, Lands Office, Kokopo, pers. comm., 2005). Only when the purchase price is fully paid are the vendor's rights, entitlements and interests transferred to the purchaser. Following approval of the sale by the Lands Department, the purchaser may decide to register the land (through the Land Tenure Conversion Act) and gain a certificate of title (freehold).

Over the last three decades there has been considerable interest in converting customary land planted to cocoa to individual freehold title. In effect, the conversion to freehold invalidates the matrilineal inheritance rights to the land of a man's sisters' sons and restarts a new matrilineal system based on a man's children. This is most common among men wishing to transfer cocoa holdings to their sons rather than to their nephews.

Commonly, customary land is transferred to individual/family ownership through payment of shell money and/or cash to the clan⁵. Although the procedures vary amongst the villages of the Gazelle Peninsula, the payment for land is often accompanied by a feast in which all clan members participate and acknowledge the transfer of the land to someone outside the matrilineal clan: that is, a man's sons rather than his sisters' sons. The payment ideally removes matrilineal inheritance claims on the land, allowing the children of the purchaser to inherit the cocoa block. However, the payment does not remove matrilineal inheritance claims in perpetuity: for each generation the daughters assume primary rights to the land. For patrilineal inheritance to be validated, each generation of males who would like their sons to inherit the land must pay compensation to their sisters and/or fulfil other kinship obligations to them. If these conditions are not met, the land can revert to matrilineal rules of inheritance, which is the default inheritance system. Thus, purchasing land does not convert matrilineal tenure to patrilineal tenure in perpetuity.

In the two LLG areas of Kokopo-Vunamami and Livuan-Reimbar 23% and 14% of cocoa stands, respectively, were planted on ‘purchase’ land. In the villages of Ulautava and Tinganavudu some clans have stopped selling clan land because of a perception of emerging land shortages. Like other villages in PNG where land pressures exist, clan members can access land for temporary subsistence gardens, but access to land for perennial cash crops is much more tightly controlled. In these situations, some young families are purchasing land away from their home villages, especially in the relatively sparsely populated region of the Bainings. They are purchasing land in these areas to secure their children’s future.

The desire to purchase land on behalf of children and plant it to cocoa in anticipation of future land shortages means that tracts of land have been planted to cocoa for future household livelihood security rather than for current household needs (see also Ghodake *et al.*, 1995). Expanding cocoa holdings to lock up land for future needs has implications for harvesting rates and pest and disease problems, particularly if those purchasing land already have adequate cocoa to meet their current income needs. Similar observations were made in some villages growing oil palm in West New Britain Province, where some families were securing clan land for their children by planting it to oil palm. This practice was especially common in villages where customary land was being sold to non-clan members (Koczberski *et al.*, 2001).

Agricultural Leasehold Land

Agricultural leasehold land is State land leased to individuals on 99 year leases. Several agricultural land settlement schemes (LSSs) based on leasehold tenure were established on the Gazelle Peninsula to promote smallholder cocoa production (see Spinks *et al.*, 1964; Singh, 1967; Fenbury, 1978). They are the Keravat, Vudal, Tokiala, Warangoi, Sigute, Ilugi, Mandras, Vunapaliting and Nengmutka LSSs. Leaseholders, the majority of whom were from the Gazelle Peninsula, were allocated 6-10 ha plots of land for the planting of cocoa.

The first LSS to be established was the Vudal Scheme, followed by settlements at Warangoi in 1959 and Ilugi in 1960 (Spinks *et al.*, 1964; Singh, 1967). In the late 1980s, with ADB funding, Sigute LSS was expanded to include approximately 127 new 6.5 ha blocks, and after the volcanic eruption at Rabaul in 1994 some further agricultural leases were allocated to families to resettle on Sigute LSS. In total, approximately 30,000 ha are under agricultural leases in ENB (W. Revel, Lands Office, Kokopo, pers. comm., 2005).

Similar to the oil palm agricultural LSSs in WNB, many of the LSSs on the Gazelle Peninsula that were established in the 1950s and 1960s are now experiencing population and economic pressures as second and third generation settlers continue residing on their parents' block (Mary Dadatliu, Lands Office, Kokopo, pers. comm., 2005). Further, as the original leaseholders pass away, there has been an increase in disputed leases coming before the Lands Office in Kokopo. There have been numerous incidences of the inheritance of LSS leasehold blocks by settlers' children being contested by matrilineal relatives. Customary practices (matrilineal inheritance) in terms of land inheritance do not apply to state leasehold land. Disputes between brothers and sisters over the transfer of leasehold title are becoming increasingly common. Often disputes over inheritance of leasehold blocks are exacerbated because the leaseholder did not leave a will⁶. Protracted disputes over inheritance of cocoa blocks can lead to production being disrupted until the dispute is resolved.

Land Tenure and Cocoa Production

To conclude, the large numbers of smallholders with cocoa planted on 'purchase' and reserve land is indicative of the land shortages present on the Gazelle Peninsula, as is the trend for smallholders to pursue strategies to accumulate tenure rights to land within the family. As this chapter has shown, people are working out various ways to resolve inheritance issues in the context of land shortages and their considerable investments of labour and capital in their cocoa blocks.

The desire to convert customary land to individual title reveals three major trends. First, it reveals a shift in attitudes and values in which sons are given preference over nephews in the inheritance of cocoa blocks. Second, it is possible that the desire to convert customary land to 'purchase' land may reflect smallholders' capital and labour investments in their cocoa blocks. Unlike temporary food gardens which may be in production for a few years before reverting to the common pool of fallow land, cocoa blocks represent considerable long-term labour investments and income potential, and for this reason there is a desire to keep these assets within the family. Third, the trend to transfer land under cocoa from customary tenure to individual title also reflects shifts in residence patterns and social and cultural changes occurring on the Gazelle Peninsula. For example, it was customary for male children to move back to their mother's village and acquire land through their mother or mother's brother, but these residence patterns are changing as males remain

living on their father's land. This is a reminder of the rapidly changing socio-cultural environment in which smallholder production occurs.

This study does not have sufficient data to make conclusive statements regarding the effects of land tenure on cocoa productivity. From interviews with smallholders and extension officers, it is clear that planting cocoa on individually registered land does not isolate the land from potential disputes and inheritance claims from matrilineal kin. Nor does it appear that customary land tenure always serves as a disincentive to replanting cocoa or is a constraint on production decisions. Our observations suggest low levels of block maintenance (especially minimal pruning of cocoa trees and shade trees – see Chapter 7) were common across a range of different tenure regimes. Further, any relationship between type of land tenure regime and smallholder productivity is likely to be masked by the influence of land shortages. The practice of tying up land for children's future needs by planting it with cocoa means that block productivity may bear little relation to type of land tenure. This, of course, has implications for cocoa farm management and investment practices. In the next chapter we begin this analysis with an investigation of household income and labour strategies.

Chapter 5

Household Income and Labour Strategies among Cocoa Producers

This chapter documents the importance of cocoa production within the broader income and labour portfolio of cocoa producing households in the two study areas. It draws on data collected during weekly visits to fourteen families and a larger socio-economic survey of 93 cocoa producing families (see Chapter 2 for details). Understanding household income and labour strategies is important for explaining productivity because most smallholder households depend on labour for cocoa from the family and extended family, with very few employing hired labour to overcome labour shortages. As identified in other studies on the Gazelle Peninsula, household labour shortages are a significant constraint on smallholder production (Ghodake *et al.*, 1995; Lummani & Nailina, 2001; Omuru & Fleming, 2001).

Household Income Portfolio

We estimate annual average income for cocoa smallholders of K1,871 for dry bean sellers and K408 for wet bean sellers¹. In the socio-economic survey, 71% and 100% of male household heads at Kokopo-Vunamami LLG and Livuan-Reimbar LLG areas respectively identified cocoa as the most important income source for the household, followed by copra and local marketing (Table 5.1). The relative importance of each income source varies between the two LLG areas and between genders. In the Livuan-Reimbar LLG area, household dependence on cocoa income is notably higher than for households in the Kokopo-Vunamami LLG area where copra is also important (Table 5.1).

Table 5.1 also reveals that cocoa producing households are not solely producing cocoa. Indeed, as depicted more clearly in Figures 5.1 and 5.2 a salient feature of cocoa producing households is the diversity of income sources and the wide range of livelihood activities in which they are engaged (see also Omuru *et al.*, 2001). The average number of income sources per household is 6.2 at Kokopo-Vunamami LLG and 4.6 at Livuan-Reimbar LLG.

The main farm and non-farm income sources other than cocoa are copra, local marketing of garden foods and betel nut, vanilla, livestock and tradestores (Figure 5.1). Vanilla production is a recent supplementary income source and its cultivation has spread rapidly on the Gazelle Peninsula.

Table 5.1. Most important income sources for men and women in the Kokopo-Vunamami and Livuan-Reimbar LLG areas (per cent of households) (n=93).

Most Important Income Source	Kokopo-Vunamami LLG		Livuan-Reimbar LLG	
	Male (%)	Female (%)	Male (%)	Female (%)
Cocoa	71	26	100	45
Copra	25	2.2	—	—
Local Marketing	2.2	48	—	53
Wage Employment	—	8.7	—	2
Village Business	—	10.9	—	—

In 1995, Ghodake *et al.* noted that none of the cocoa smallholders in their Gazelle Peninsula sample grew vanilla, despite high world prices prevailing at the time of their fieldwork. The recent rapid uptake of vanilla by smallholders on the Gazelle Peninsula is partly a response to greater market access and high prices during the period 2000-2004. It is also a reflection of smallholders' desire to diversify and increase their incomes. At the time of the socio-economic survey in December 2003, prices for vanilla were beginning to decline, and by mid 2005 vanilla prices and market access had both been substantially reduced, causing great disappointment and frustration for growers.

Whilst many of the income activities depicted in Figure 5.1 contribute less to total household income than cocoa, and some provide very irregular sources of income (e.g., sales of vanilla or casual labouring), the range of household income sources highlights the many economic activities pulling on smallholders' time, labour and, in some cases, investment capital (e.g., for tradestores and vehicles) (Figure 5.2). It is more common for smallholders to invest cocoa income in new or ongoing businesses such as tradestores, poultry and transport businesses, which have high social status, than to reinvest their earnings in their cocoa blocks for rehabilitation, replanting, or employing hired labour for block maintenance tasks. Omuru (2001) reported that only 4% of the cocoa income of ENB smallholders was reinvested in their blocks. Often during cocoa flushes there is considerable social pressure on growers to invest cocoa income in communal *bisnis* enterprises that give status to the group. Some interviewees reported making these investments in the knowledge that there was little probability of these businesses being successful (see Curry, 2007 for discussion of village investment decisions).

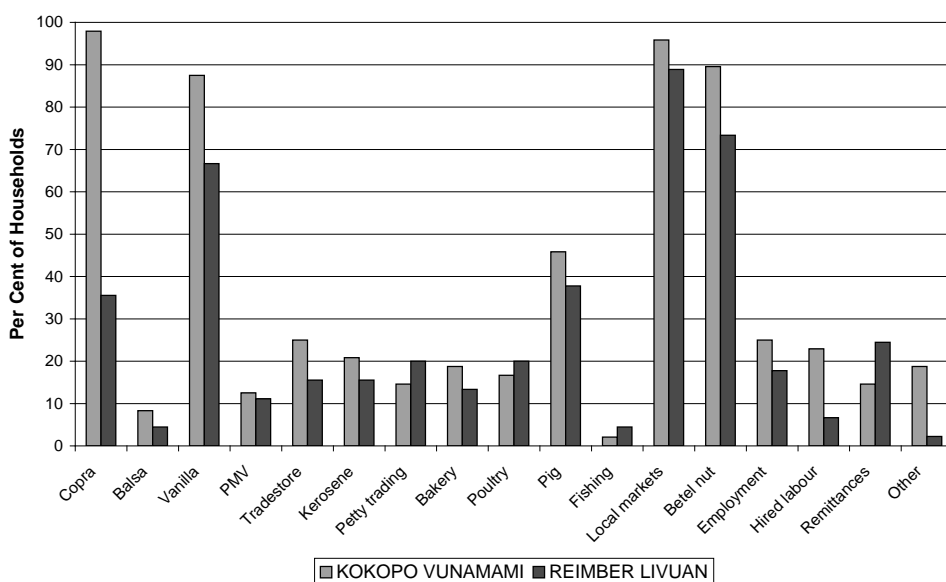


Figure 5.1. Non-cocoa income sources of cocoa smallholder households at Kokopo-Vunamami and Livuan-Reimbar LLG areas (source: socio-economic survey).

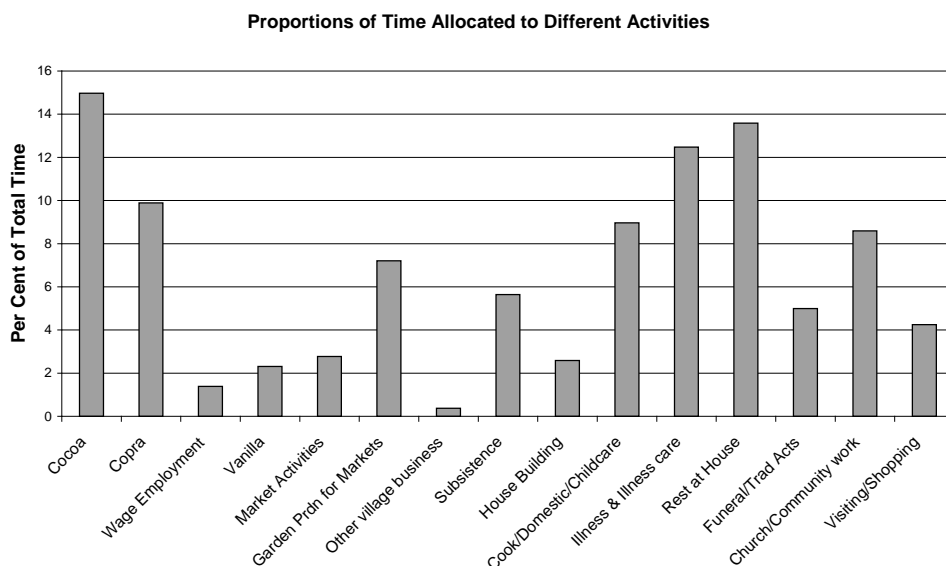


Figure 5.2. Proportions of time allocated to different activities by cocoa smallholder households at Kokopo-Vunamami and Livuan-Reimbar LLGs combined (source: weekly survey data²).



Plate 5.1. Vanilla plot of cocoa farmer at Ulautava Village.



Plate 5.2. Local produce market at Keravat.

Intra-household Income Distribution

The diverse income sources of smallholder households (Figure 5.1) also reveal something about the income distribution within households. Whilst cocoa may be the dominant income source for one or more family members, especially male household heads, other family members such as wives or co-resident married sons and daughters, may be more reliant on other income sources. When female household heads were asked separately from their husbands to rank their three main income sources, income from local markets was ranked higher than cocoa (Table 5.1). Men, however, ranked cocoa as the main income source of the household (Table 5.1). In the Kokopo-Vunamami LLG area, only 26% of women ranked cocoa income above market income. Local markets were considered the most important source of income for almost half (48%) of the women. In the Livuan-Reimbar LLG area, 45% of women ranked cocoa as their most important income source, compared with 53% of women who stated market income was their primary income source (Table 5.1).

The importance of local markets as an income source for women indicates where women are investing their time and labour, and suggests that women have greater control over market income compared with income from cocoa. In cocoa production, women typically retain the income they earn from small harvests of wet bean, and the larger income from the more profitable dry bean production and sales is usually controlled by male household heads (see also Lummani, 2006 who reports a similar situation amongst cocoa households in the Buin District of Bougainville). Men's control over the bulk of the income from dry bean sales is similar to income distribution patterns within families found in other commodity crops in PNG, such as coffee, copra and oil palm. In these other crops, men have tended to claim ownership rights over the bulk of the income, leaving women with a much smaller share of the total income, and a relatively lower rate of return on their labour compared with men. As demonstrated in coffee and oil palm in PNG, the poor remuneration of women's labour has been a major factor constraining the supply of female labour in coffee and oil palm production to the extent that potential production and income were significantly reduced (see Overfield, 1998; Koczberski *et al.*, 2001; Koczberski, 2007)³.

Portfolio of Household Labour Activities

The diverse range of livelihood strategies pursued by cocoa producing smallholders is reflected in the patterns of labour allocation recorded amongst households participating in the weekly surveys. As shown in Figures 5.3–5.6, households allocate their labour to a wide range of economic and social activities. Moreover, most activities display marked gender differences in the time allocated to specific tasks, especially those related to income earning and household domestic and child/health care activities. Differences are less marked between the sexes in the amounts of time allocated to subsistence, communal and leisure activities.

Gender Differences in Labour Allocation in Cocoa, Copra and Local Marketing

There are distinct differences between the two study sites in how men and women allocate their labour to the three main income activities of cocoa and copra production and local marketing of garden produce (Figures 5.3–5.6). In the Kokopo-Vunamami LLG villages, where most households have combined cocoa-coconut holdings and sell wet bean predominantly (see below), men spend 12% and 18% of their total time on cocoa and copra respectively compared with 10% and 8% for women (Figure 5.5). Whilst there is little difference between men and women in the time they allocate to cocoa, men devote more than twice as much time to copra production than do women (Figures 5.3 and 5.5). Overall, copra production is the dominant economic activity of men (Figure 5.5), and the greater time men spend on copra compared with women relates largely to copra processing and marketing. Processing copra is a long and laborious task that is spread over several days, and is undertaken largely by men. The lengthy period of processing allows men a greater claim than women on copra income (see Table 5.1).

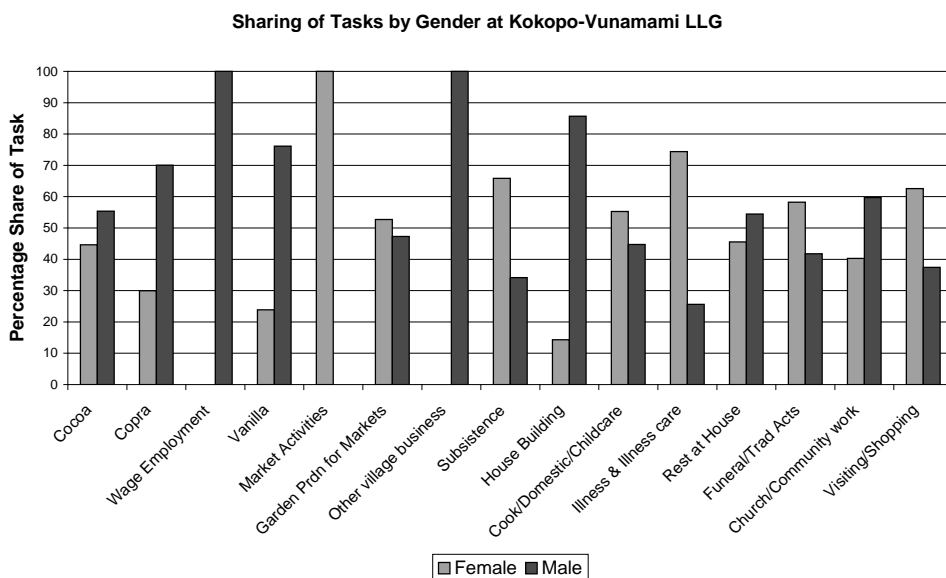


Fig 5.3. Sharing of tasks by gender at Kokopo-Vunamami LLG (source: weekly survey data).

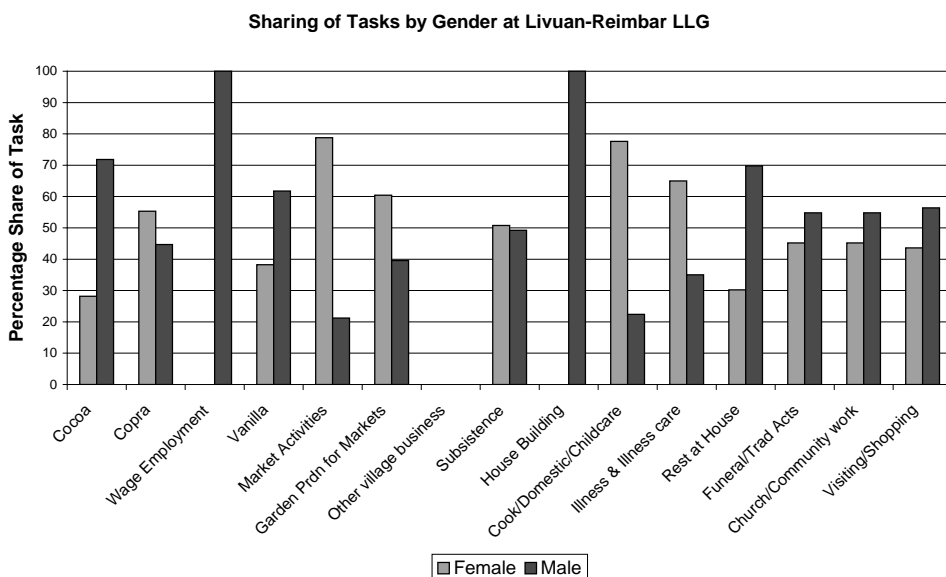


Fig 5.4. Sharing of tasks by gender at Livuan-Reimbar LLG (source: weekly survey data).

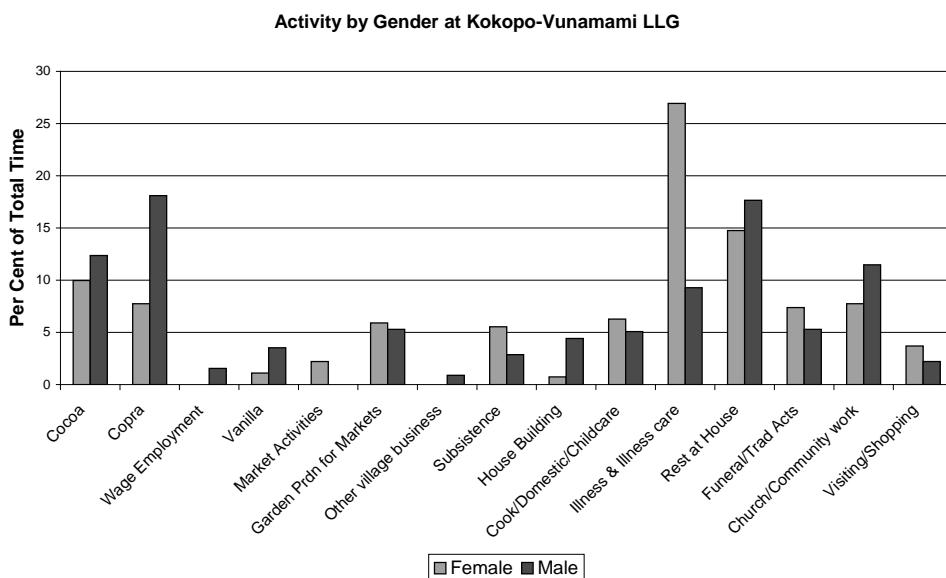


Fig 5.5. Activity by gender at Kokopo-Vunamami LLG (source: weekly survey data).

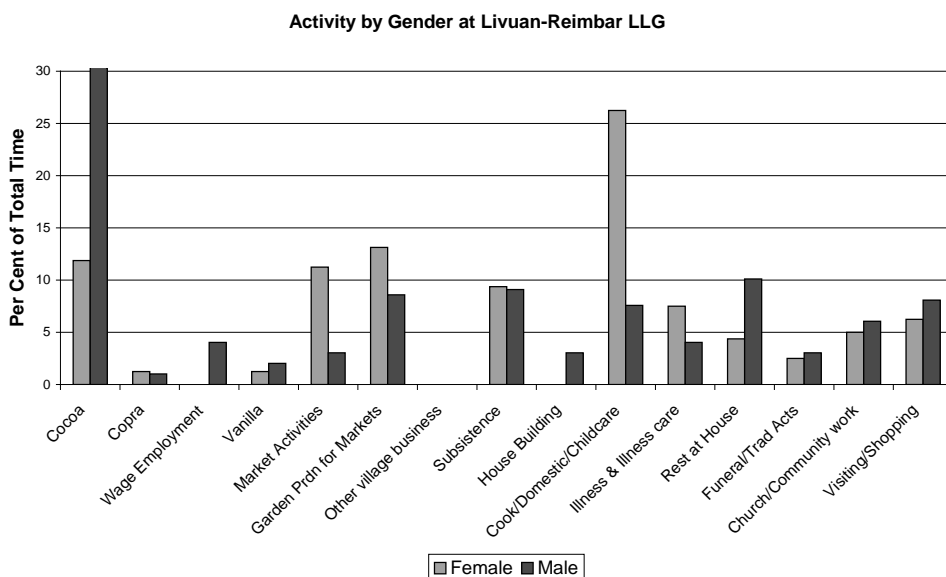


Fig 5.6. Activity by gender at Livuan-Reimbar LLG (source: weekly survey data).

In the Livuan-Reimbar LLG villages, copra production is a minor activity for both men and women (Figure 5.6). In contrast to Kokopo-Vunamami LLG villages, the main income earning activities in terms of labour time are cocoa production and marketing, where there are also distinct gender differences (Figure 5.4). Men spend 30% and 12% of their time on cocoa production and market-related activities⁴ respectively, compared with 12% and 24% for women (Figure 5.6). Interestingly, men in the Livuan-Reimbar LLG villages spend almost the same amount of time in cocoa production as do men spend on cocoa and copra production combined in the Kokopo-Vunamami LLG villages (Figures 5.5 and 5.6). The differences in the labour allocated to cocoa and market-related activities by men and women in the Livuan-Reimbar LLG villages are depicted in Figure 5.4 which show women contribute less than a third of the labour to cocoa production, and men less than a one-half of the labour that is allocated to market income earning activities (including garden production for marketing). Thus, cocoa production in the Livuan-Reimbar LLG villages, where dry bean processing is common (see below), is predominantly a male activity, while women direct their labour to income activities based on local marketing of garden produce.

The gender division of labour in cocoa production for Livuan-Reimbar LLG villages presents an interesting contrast to Kokopo-Vunamami LLG villages. In the latter LLG villages, where wet bean sales predominate, labour allocated to cocoa production dominates the income earning activities of women, and women contribute around 45% of the labour to cocoa production (Figures 5.3 and 5.5). In contrast, in the Livuan-Reimbar LLG villages, where dry bean sales predominate, women's share of the cocoa work relative to men is much less (Figure 5.4).

Whilst there is not a rigid division of labour in the harvesting of cocoa, the lengthy process of fermenting and drying cocoa beans is typically a male activity. Harvesting tasks are performed by men, women and children, and women's labour contribution largely ceases once the wet bean is harvested and carried to the village fermentary. Male family members (the husband and adult sons) tend to arrange transport of firewood for drying and they supervise the fermentation and drying process. The male household head typically takes responsibility for transporting the dry bean to the nearest town for sale. As with copra, women's contribution to processing is minimal. Key differences in the labour strategies of wet and dry bean production are explained further in Chapter 6.

Competing Demands on Labour

Figures 5.5 and 5.6 show that women's labour contribution to commodity crop production (i.e. cocoa or cocoa/copra production) is much less than that of men. Given the wide range of activities in which men and women are involved, it is likely that, at times, these other activities (e.g., subsistence production, childcare, community activities, etc.) draw labour away from cocoa production (particularly block maintenance tasks). Labour for cocoa may also be constrained by illness and health care requirements, both of which consumed a substantial amount of women's time at Kokopo-Vunamami LLG villages (Figure 5.5). High illness rates were reported during an exceptionally wet period in May-July 2004 (see Chapter 2) when many children and elderly villagers suffered from malaria and other illnesses. The high illness rate in Kokopo-Vunamami LLG villages compared with Livuan-Reimbar LLG villages also reflects the older population in the former villages.

Further support for the claim that labour for cocoa production may compete with other income and livelihood activities is derived from smallholders themselves. When asked to identify what they viewed as the four main constraints on or barriers to improving cocoa production, labour shortages were ranked third behind poor block condition and the theft of cocoa pods. These results concur with other smallholder studies on the Gazelle Peninsula that have identified labour shortages as a constraint on smallholder cocoa output (e.g., Ghodake *et al.*, 1995; Lummani & Nailina, 2001).

It is also apparent from Figure 5.2 that villagers place a great deal of importance on activities that are not directly related to cash income, but which are central for maintaining social and kinship networks and community cohesiveness (i.e., for maintaining social capital). At times, these activities draw smallholders' time and labour away from cocoa, but at other times they have the opposite effect by motivating smallholders to commit extra time and labour to cocoa production to raise funds for social purposes. For example, villagers devote much time and labour to church, community and traditional activities (Figure 5.2), and it is not uncommon for family members to make substantial cash donations to the church or to contribute financially to a community or customary event. Often these financial contributions are either in the form of large cash donations/payments following the sale of cocoa to exporters or as bags of dry cocoa or copra. Such church and community obligations remind us that cocoa production is not just to raise household income for consumption, but also serves important social purposes. In summary, cocoa smallholders engage in a diverse range of livelihood activities besides cocoa production such

as subsistence food production, other export cash crop production (e.g. copra and vanilla production), local marketing and community, customary and church activities. All these activities are important for maintaining the economic and social well-being of families, extended kinship groups and village communities. These non-cocoa pursuits influence the amount of time and labour committed by household members to cocoa production, resulting at times in labour shortages in cocoa production. Further, the limited time women allocate to dry bean production relative to men is an important gender division of labour that may reflect men's greater control over income from dry bean sales.

In the next chapter we examine further the differences between wet and dry bean sellers and the range of other factors influencing the production strategies of households.

Chapter 6

Wet Bean and Dry Bean Cocoa Production

This chapter identifies and describes the factors (beyond access to processing facilities) that determine a household's cocoa production strategy. In particular the discussion focuses on the key differences in labour and farm management practices between households selling wet bean and those selling dry bean. We estimated an annual income of K1,871 for dry bean sellers and K408 for wet bean sellers. The considerably lower income of wet bean sellers relative to dry bean sellers has been noted in several smallholder studies on the Gazelle Peninsula and elsewhere in PNG (Table 6.1). For example, in ENB Omuru (2005) noted that gross margins for smallholder farmers selling dry bean were 69.4% higher than for those selling wet bean¹.

Table 6.1. Annual wet and dry bean cocoa incomes for smallholders in PNG.

Author (year)	Wet Bean Annual Income	Dry Bean Annual Income
Yarbro & Noble (1989)	K130-K472 (East Sepik and Madang provinces)*.	K2,200 – K2,300 (East New Britain and Oro provinces)*.
Lummani (2006)	K269 (Buin District, Bougainville).	K477 (Buin District, Bougainville).
Present Study (2003-05)**	K408 (Gazelle Peninsula, East New Britain).	K1,871 (Gazelle Peninsula, East New Britain).

* Most smallholders surveyed in East Sepik and Madang Provinces sold wet bean, whilst in East New Britain and Oro Provinces most respondents sold dry bean.

** See Note 1 in Chapter 5 for income calculations.

Because most ENB cocoa growers are wet bean sellers (Ghodake *et al*, 1995; Omuru *et al.*, 2001), total cocoa income and returns to labour are lower than if smallholders were dry bean producers, and it is likely that cocoa productivity is also low. The lower returns from wet bean sales than from dry bean sales have implications for the levels of farm investment, farm management practices, harvesting rates and household income and labour strategies.

To identify ways to raise smallholder incomes and productivity it is first necessary to understand key differences in labour and farm management practices between wet and dry bean sellers. Using data gathered from the surveys and interviews with cocoa households in the Kokopo-Vunamami LLG and Livuan-Reimbar LLG areas, we sought answers to three sets of inter-related questions:

1. What contribution does cocoa make to total household income for wet and dry bean producing households? Do wet bean sellers pursue additional income sources to compensate for the low returns from selling wet bean?
2. What effect does labour availability have on a household's cocoa production strategy? Do wet bean sellers have greater difficulty mobilising labour for harvesting than do dry bean producers?
3. To what extent does the age and condition of a cocoa block influence the production strategy of a household? Are old, unproductive and difficult-to-access blocks more likely to be associated with wet bean production strategies?

Income Strategies of Wet Bean and Dry Bean Selling Households

In this section we analyse the weekly income data for the three main sources of household income: cocoa, copra and local food marketing. This will enable us to examine differences in the types of income and labour strategies pursued by wet bean and dry bean households and how these strategies affect block maintenance and other investments in cocoa production. Whilst the sample size (see Chapter 2) at Kokopo-Vunamami and Livuan-Reimbar LLGs is too small to draw any firm conclusions for the Gazelle Peninsula, the analysis provides insights into some of the key differences between households selling wet bean and dry bean.

The importance of cocoa to total household income is related to whether a household sells mainly wet or dry bean (Table 5.1). Dry bean households tend to be more narrowly focused on cocoa production than wet bean households, with the latter tending to have one or more non-cocoa incomes making an important contribution to total household income. For predominantly dry bean selling households, cocoa income constitutes 77% of total household income, and cocoa tends to be the major income source throughout the year across both flush and non-flush periods. Most dry bean households were from villages in

the Livuan-Reimbar LLG area and, as shown in Table 5.1, cocoa dominates the income strategies of households in this LLG area. This was confirmed by the larger socio-economic survey which found that 100% of sample households in this LLG area reported selling dry bean predominantly.

For households that sold primarily wet bean, income from marketing of garden produce and/or copra production was of greater relative importance to total household income than cocoa earnings for part or most of the year. In wet bean selling households, income from cocoa constituted, on average, 40% of total household income. The average income per wet bean sale of K17.00 (mean of 24 sales/year) is much less than the average income of K374.22 (mean of 5 sales/ year) earned for each dry bean sale. Given the relatively low income earned from cocoa by wet bean sellers (Table 6.1), they are more likely to direct a larger proportion of household labour to other income activities where the returns to labour are better. Indeed, in Kokopo-Vunamami LLG where most wet bean sellers resided, men committed more labour to copra than cocoa (Chapter 5). As discussed further in Chapter 8, when a cocoa block is not providing sufficient income to meet the many cash demands on a family such as school fees, family members will divert their labour to more profitable activities and/or less labour-intensive activities. In this way, wet and dry bean sellers appear to differ not only in the proportions of their total household incomes derived from cocoa, but also in their broader household labour and income strategies.

Differences in income strategies of wet and dry bean sellers cannot be explained simply by dry bean sellers having better access to processing facilities or possessing larger cocoa holdings². Indeed, all but one wet bean seller household had larger holdings of cocoa than the dry bean seller households. Although the small size of the sample limits the conclusions that can be drawn from these data, it appears that household income portfolios and cocoa production strategies are better explained by a range of other factors. For example, when families settled at Tabaule and Bulupa in the Livuan-Reimbar LLG in the 1980s, they were unable to establish coconuts as cocoa shade because of the arrival in the province during the Second World War of the *Oryctes Rhinoceros* Beetle, a major pest of coconuts³. Copra was therefore a much less significant income source for Tabaule and Bulupa families and only an option for those households that retained access rights to old coconut stands in their home villages. In contrast, when cocoa was introduced in the 1960s and 1970s to the Kokopo-Vunamami LLG area, where the majority of wet bean sellers reside, it was established in existing coconut plantations and/or under

coconuts, providing villagers with income from two commodity crops. Given the limited access to an alternative commodity crop (i.e., copra) at Tabaule and Bulupa, households allocate more labour to cocoa production and maximise their returns by selling almost all the cocoa crop as dry bean.

Labour Strategies of Wet Bean and Dry Bean Selling Households

Just as there are differences in the income strategies of wet and dry bean sellers, there are also important differences in the way that they organise and recruit labour for cocoa production. Key differences in the cocoa production strategies of wet and dry bean households are summarised in Table 6.2.

A significant difference between wet and dry bean sellers is that dry bean producers rely on a ready supply of labour from the household and extended family (Table 6.2). The larger quantities of bean harvested and the longer periods of harvesting required for dry bean production involve a mean 4.4 labourers working for 2.3 days per dry bean sale. Much of this labour is provided by family members (especially males), with supplementary labour drawn from the extended family (harvesting and processing).

Dry bean producers also require access to processing facilities (fermentary and dryer) and transport for carting firewood to the dryer and the processed crop to exporters in town (Plate 6.1). Commonly, members of the same social and kinship groups share processing facilities, even though it is illegal for people without licenses from the Cocoa Board to operate cocoa fermentaries and dryers. Several families in the weekly surveys producing dry bean did not have their own processing facilities and used fermentaries belonging to relatives. Also, male household heads rely on their sons and often other male relatives to assist with the fermentation and drying process. The male household head supervising processing usually takes responsibility for the sale of dry bean and the distribution of the resultant income. Hence, a dry bean household requires good access to labour from the immediate and extended family to be able to mobilise the large cooperative work groups necessary. In contrast, wet bean sellers with shorter harvesting rounds and smaller quantities of harvested bean, are less dependent on cooperative labour strategies and rarely need to mobilise harvesting labour from the extended family. Wet bean harvest groups are smaller than dry bean harvest groups with a mean of 1.78 harvesters working for 0.36 days per sale (Table 6.2).

Table 6.2. Key differences in cocoa production strategies between wet and dry bean sellers.

Wet Bean Producers*	Dry Bean Producers*
<p>Duration of a harvest round short. Average 0.36 days.</p> <p>Individual harvester or very small harvesting groups. Average 1.78 labourers per harvest round (1.38 adults and 0.39 children per harvest round)**.</p> <p>Average number of labour days*** spent on a wet bean harvest is 0.68.</p> <p>Women and children (female mostly) more likely than men to be involved in wet bean harvesting (48% of the total time and labour is contributed by adult women).</p> <p>Recruitment of non-family labour less common, but if recruited mostly young females (9.6% of total labour is contributed by extended family).</p> <p>Harvester tends to sell crop and control income earned.</p> <p>Average weight of cocoa sold per harvest round is 17.7 kg.</p> <p>Average income earned per harvest round is K17.00.</p> <p>Income spent on immediate household consumption needs (e.g., tinned fish, rice, soap, kerosene) or for church donation.</p> <p>Cocoa block nearest residence harvested more frequently than blocks further away.</p> <p>Cocoa block maintenance negligible.</p> <p>Transport costs nil or low (wet bean carried in bag or basket to processor for sale).</p> <p>Beans sold locally, usually in village.</p>	<p>Longer harvest rounds. Average 2.3 days.</p> <p>More family co-operative harvests, involving most family members.</p> <p>Average number of workers per harvest sale is 4.4 (average 3.3 adults and 1.1 children per harvest sale)**.</p> <p>Average number of labour days*** per harvest sale is 10.46.</p> <p>More adult males than females involved in dry bean harvesting (41% of the total time and labour contributed by men).</p> <p>Recruitment of non-family labour more common, typically adult males (16.1% of labour contributed by extended family).</p> <p>Male household head tends to sell crop and control distribution of income earned.</p> <p>Average weight of dry cocoa sold per harvest round is 91.7 kg.</p> <p>Average income earned per harvest sale K374.22.</p> <p>Income saved and/or used for larger personal and household expenses (e.g., school fees, house building, customary payments and investment in other businesses such as tradestore stock, poultry or building materials).</p> <p>Some block maintenance undertaken (almost entirely grass slashing).</p> <p>Transport costs significant (wet bean to fermentary/dryer, firewood to dryer, dry bean to exporter in town).</p>

* Data from 67 wet bean sales, and 41 dry bean sales among sample households during the two survey periods in 2003 and 2004.

** An adult is defined as anyone over the age of 14.

*** A labour day is the average number of harvesting days multiplied by the number of workers per harvest sale.



Plate 6.1. Transporting firewood and processed dry cocoa beans.



Plate 6.2. Carrying a basket of wet cocoa beans to a local buying point.

Wet bean harvesting is typically undertaken by women usually working alone or with young children, with the cash income (*kwiik moni*) spent on small items like store foods and other items for immediate consumption. Women often claimed that these short harvesting visits were driven by the need to purchase an item for use that day or for church donations. Less often, a husband and wife may work together to harvest wet bean. In our sample households, most of the men working alone collecting wet bean were elderly and widowed. Whilst relatives from the extended family contributed 9.6% of the harvesting labour for wet bean sales, their labour is recruited not so much to overcome labour shortages, but rather as a social obligation or goodwill gesture to help a relative. Many elderly households often called on their young grandchildren to assist with harvesting. The children often shared some of the income or food that was purchased from the earnings from wet bean sales.

Wet bean sellers are less dependent than dry bean producers on transport because the small harvests (17.7 kg) are usually sold locally and can be carried in a basket on foot to the buying point (Plate 6.2).

Labour Availability and the Production Strategies of Wet Bean and Dry Bean Sellers

The different labour strategies and family and kinship networks mobilised for cocoa production by wet and dry bean selling households described above raise the question of whether wet bean households find it more difficult to mobilise labour than dry bean households. The sample size was too small to draw firm conclusions. Given the centrality of household labour in cocoa production and the minimal use of hired labour, access to family labour is likely to be a factor determining production levels and the type of production strategy (wet bean or dry bean) adopted by households.

High production levels are contingent on an adequate supply of labour. Interview and survey data reveal that smallholder households with an adequate supply of labour for cocoa have certain characteristics. These are summarised in Box 6.1.

A significant feature of households where labour supply is easily mobilised is the good working relationships between the male household head and other family members. Harmonious relationships among family members help ensure their ongoing commitment to and participation in cocoa production. This is particularly important for maintaining a dry bean production strategy and for meeting peak labour demands during flush periods.

Box 6.1. Characteristics of households with an adequate supply of labour for cocoa production.

CHARACTERISTICS OF HOUSEHOLDS WITH AN ADEQUATE SUPPLY OF LABOUR FOR COCOA PRODUCTION

Access to the labour of unmarried and/or married sons.

Reside in multi-generational and extended family units (houses clustered together) with multi-household production units (for subsistence and cash cropping).

Household works co-operatively and harmoniously as a family group.

Household is willing to utilise indigenous mechanisms of labour mobilisation when necessary to maintain cocoa production during high crop periods.

The head of the extended family unit (the father) maintains control over family labour (in particular the labour of adult sons).

Few intra-household disputes over labour remuneration.

Household head allocates cocoa harvests or cocoa beans to adult household members and other relatives.

Harmonious working relationships within the family are dependent on individual family members being satisfied with their share of cocoa income (i.e., a perception that income distribution is fair and the household head is not wasting the income but contributing to the economic and social well-being of the family group). By judiciously allocating harvest rounds to co-resident married sons and daughters, a male household head builds goodwill (social capital) that enables him to draw on the unpaid labour and support of his married children when necessary. For instance, when a co-resident son assists his father with cocoa production, the son may expect his father to contribute to immediate and future expenses (such as school fees and bridewealth). Thus, labour supply for cocoa production does not reflect only the demographic characteristics of the household (number of able-bodied workers). The failure of the household head to meet obligations and behave in socially responsible ways can disrupt household labour supply.

Another important characteristic of households with adequate labour is their ability to utilise traditional mechanisms of labour mobilisation. This can take many forms, and may involve long-term measures such as adoption of children or recruiting relatives (such as nephews who are short of land) to reside with the family. More commonly, traditional strategies are short-term and may involve participation in reciprocal labour exchange groups (such as *warvemal*) that are usually based on kinship. Each group member benefits from the pooled labour of other group members. Labour exchange is usually employed for labour-intensive tasks such as planting, grass slashing prior to harvesting, harvesting during high crop periods, and processing.

Short-term strategies for mobilising labour are especially useful during flush periods when work demands are high and dry bean is produced. These strategies are similar to traditional strategies of mobilising labour for subsistence production, and like them they lie outside the market economy and are not dependent on market-based relations of production. In other words, they do not depend on wage labour. People recruited through these strategies are commonly presented with cooked food and occasionally some cash as a token of appreciation for their gift of labour. It would be incorrect to interpret such gifts of cash and food as market transactions. The cash given is not viewed as a 'payment' for labour. Growers made it clear during interviews that the cash given to family and relatives working on cocoa was a 'present' signifying the blockholder's good relationship with the helper and appreciation for their help and generosity. Often growers explained a gift to a helper as '*mi hamamasim em tasol*' (pleasing) the helper. Usually there is an obligation by the cocoa grower receiving the labour to reciprocate labour, money or support at some later date. Those household heads adept at managing reciprocal labour exchanges are more able to ensure an adequate supply of labour during peak labour demand periods like the cocoa flush.

We have already noted that one fifth of survey households identified labour shortages as a constraint on production. Families experiencing labour shortages tend to have one or more of the characteristics listed in Box 6.2. For a variety of reasons households experiencing labour shortages are unable or unwilling to overcome labour supply constraints by recruiting family labour, participating in reciprocal labour exchange strategies, or hiring labour. The result is low levels of household cocoa production, which in turn is likely to be reflected in a wet bean production strategy rather than a dry bean production strategy.

Box 6.2. Characteristics of households with labour supply constraints for cocoa production.

CHARACTERISTICS OF HOUSEHOLDS WITH LABOUR SUPPLY CONSTRAINTS FOR COCOA PRODUCTION

Demographic characteristics (e.g., small family size, young family with dependants, absence of adult family members, elderly household heads without co-resident sons, young family with preschool children).

Short or long-term health problems of adult family members.

Competing economic demands on household labour (e.g., formal employment, alternative cash crops).

Non-economic activities competing with labour for cocoa production (e.g., customary activities, church activities).

Under-utilisation of available family labour (e.g., inadequate remuneration of family members leads them to withdraw their labour from cocoa production).

Perception that household head is not fulfilling his obligations to the family.

Minimal use of traditional strategies of labour mobilisation (e.g., reciprocal exchange labour).

Minimal use of hired labour.

The characteristics of labour-short households listed in Box 6.2 indicate that labour constraints may be temporary (resulting from illness or the diversion of labour to other activities), or they may be more enduring because of household demographic factors, such as an elderly household head without co-resident sons (see Chapter 5). Sometimes, as pointed out above, family members are discouraged from providing labour when they feel they are not being adequately remunerated for their labour. As noted in Chapter 5, women commonly divert their labour away from certain types of export crop production when they believe that they, or their family as a whole, are not benefiting from the income earned. Similarly, a young son seeking economic independence from his father may resent giving labour which he believes is not being remunerated fairly. Whilst we did not observe many cases of sons withdrawing their labour from cocoa production, we were told that it was quite common⁴.

Finally, it is also likely that some household heads lack the status or skills to recruit and manage labour from the extended family or to organise reciprocal labour groups. Without the managerial ability to organise the large cooperative labour groups necessary for dry bean production, some farmers may be limited to selling wet bean.

Understanding why some households are unwilling or unable to overcome labour shortages and how labour availability influences a household's cocoa harvesting strategy (wet bean or dry bean) requires further attention in cocoa research. In other commodity crop industries, such as oil palm, labour shortages were found to be a key constraint on productivity, especially on the highly populated oil palm Land Settlement Schemes, where disputes over the payment of labour can lead to sons and wives withdrawing their labour (see Koczberski *et al.*, 2001; Curry & Koczberski, 2004).

Block Condition and Crop Accessibility

An adequate supply of labour may not be sufficient by itself to maintain a dry bean production strategy. There is considerable evidence to suggest that other factors such as the age of a stand of cocoa trees, block condition and degree of accessibility for harvesting are important influences on household production strategies. These three factors affect the quantity of ripe accessible fruit, which in turn influences strategies of cocoa production. A plentiful supply of ripe crop is more likely to induce smallholders to engage in dry bean production, whereas harvesting cocoa for wet bean sales occurs when there are few ripe pods accessible for harvesting. Low crop availability can be associated with non-flush periods or old and overgrown blocks where yields are lower, access is difficult and high pest and disease levels reduce the number of healthy pods for harvesting.

Dry bean producers tend to have younger, more productive blocks, while wet bean sellers tend to have older stands of cocoa with high levels of pests and diseases. In the Kokopo-Vunamami LLG villages, where most wet bean selling households reside, the median year of planting cocoa stands was 1991 compared with 1995 in the Livuan-Reimbar LLG where dry bean sales are more common. While the data are inconclusive, they suggest the two main production strategies are related to the age and condition of cocoa holdings.

The age of a block affects the availability of ripe healthy pods in several ways. First, some cocoa varieties experience sharp yield declines at about seven or eight years of age (see below) which significantly reduces the crop. Second, as discussed in detail in the next chapter, most mature cocoa blocks over 7 years of age are characterised by tall and dense growth of cocoa trees under heavy shade because of the long-term neglect of pruning and shade control. Ghodake *et al.* (1995) noted that block management was much poorer in mature cocoa stands than in young stands. Minimal pruning and shade control on older blocks exacerbates pest and disease problems by creating a moist micro-climate conducive to pest and disease outbreaks. The combined outcome of these factors is smaller quantities of ripe healthy pods available for harvesting.

The modern varieties of cocoa such as the SG2 hybrids and hybrid clones, while being very high yielding in their early years, experience dramatic yield declines at a relatively young age. CCRI research indicated that the hybrids “show a considerable yield decline after five to six years” (CCRI, 1999 p.44). More recent CCI research also reported significant yield declines in some hybrid clones (CCI, 2004) (Figure 6.3). This is in marked contrast to the results of some of the Trinitario trials in the 1950s and 1960s at LAES which reported mean annual yields of dry bean of over 927 kg/ha in cocoa trees of 10 to 17 years of age (Powell, 1991). Although the Trinitario were not nearly as high yielding as the modern varieties in their early years, they had much greater longevity and yield consistency over a longer period (Figure 6.4). In short, they had several characteristics that might make them suitable to the low input smallholder production strategy.

The marked yield decline of the modern cocoa varieties at five to six years old, combined with minimal pruning and shade control measures, means that cocoa stands become overgrown at around the same time that yield decline sets in, exacerbating the problem of low crop availability. The low density of easily accessible ripe pods is a disincentive to work in the block, and the returns to labour are considered insufficient to warrant the mobilisation of family labour groups for harvesting. At this stage only small wet bean harvests are carried out in short forays into the block by individual harvesters, usually women. Little or no labour is expended on block management. It seems that smallholders adjust harvesting and farm management inputs in response to the amount of crop that is easily accessible for harvesting.

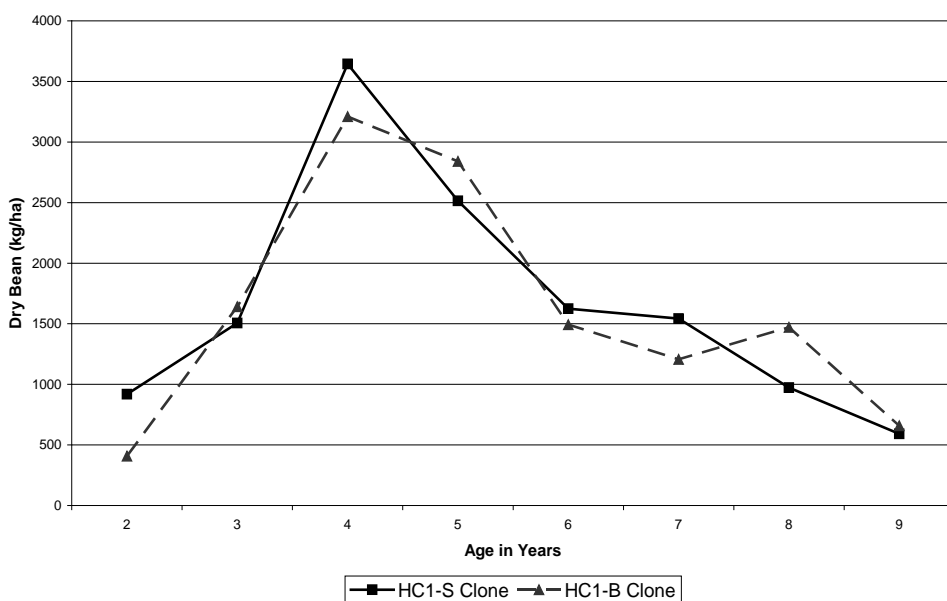


Figure 6.3. Average dry bean yield distribution of the HC1-B and HC1-S released clone varieties from age two to nine years (CCI Trial 141).

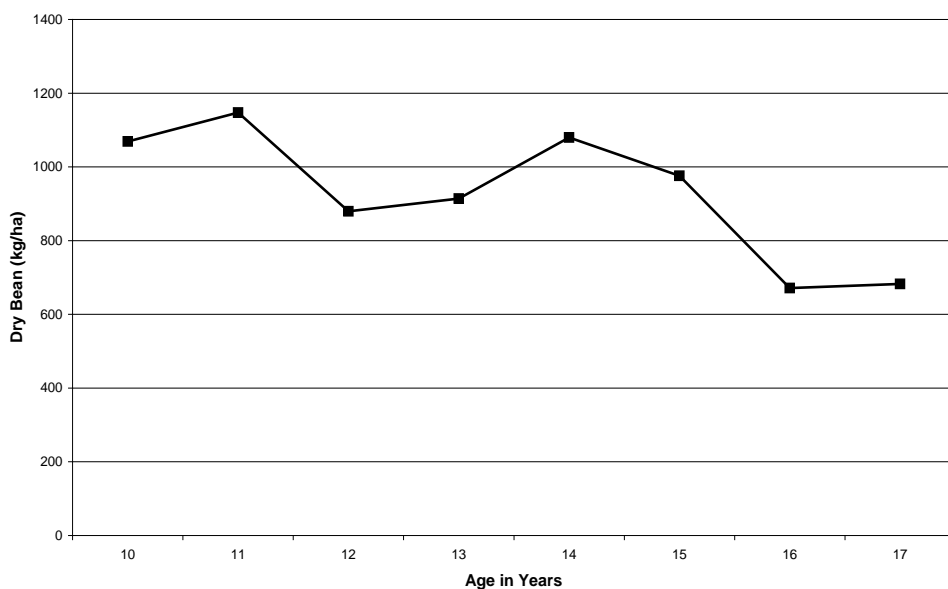


Figure 6.4. Average dry bean yield of Trinitario trials from 1958/59 to 1965/66 (source: Powell, 1991).

Although other variables, such as labour supply, price and access to a fermentary are important for explaining smallholder harvesting strategies, the quantity of accessible healthy ripe pods is critically important and must be above some minimum threshold quantity for smallholders to invest time and labour in their cocoa blocks. If the quantity of ripe pods falls below this threshold level, smallholders will switch to strategies of lower labour inputs and will not invest labour in grass slashing. On the other hand, when the quantity of healthy ripe crop is above this threshold level (e.g., during flush periods or on high-yielding younger blocks), growers are motivated to spend more time on their blocks, both grass slashing and harvesting for dry bean production. Indeed, farmers with both young and old cocoa blocks invest more harvesting and maintenance labour in their higher producing younger blocks where access is easier and where pest and disease levels are lower.

This crop ‘quantity threshold’ works in a similar way to the more widely recognised ‘commodity price threshold’ for PNG smallholders. Several smallholder studies in PNG have argued that production levels, block maintenance levels and general interest in cocoa are related to price (e.g., Godyn, 1974; George, 1994; Ghodake *et al.*, 1995; Omuru *et al.*, 2001). While price is undoubtedly important, our observations lead us to conclude that the quantity of accessible crop is a more important factor over a wide price range. In other words, the labour response to variations in the quantity of ripe healthy pods available for harvesting is more elastic than the labour supply response to cocoa prices⁵. The same is true in the oil palm smallholder sector (Curry *et al.*, 2005). The condition of the block and the availability of ripe pods have more influence on smallholders’ harvesting and production strategies than price.

The variations in labour supply associated with the condition of the cocoa block have their parallels in labour strategies in subsistence food production. For instance, on the Gazelle Peninsula, and in many other areas of PNG, subsistence food gardens are cultivated intensively for up to three years with considerable labour inputs for clearing and preparing the site, the planting of food crops, weeding and harvesting, after which the garden enters a low labour input phase until its abandonment to the fallow. Typically, as food gardens in the Gazelle Peninsula move through the cultivation cycle, labour inputs and management techniques change. Crop diversity decreases with the age of the garden, and perennial staples such as bananas (*Musa spp*), Singapore taro (*Xanthosoma sagittifolium*), sugar cane (*Saccharum spp*), and pitpit (*Saccharum edule*) are planted during the later phases of the garden cycle, after the harvesting of short-term crops such as green leaf vegetables, corn or

pumpkin (Bourke, 1976; Ghodake *et al.*, 1995). As the garden enters the fallow phase some perennials such as taro and banana continue to be harvested, but labour inputs are very low. Visits to the garden become less frequent, and are usually made by women.

Similarly, in the Wosera area in the East Sepik Province food gardens are cultivated intensively for two to three years with considerable labour inputs involving the mobilisation of extended family groups for the clearing and firing of the bush, the planting of food crops, weeding and harvesting⁶. Typically, in these areas one or two crops of yams (*Dioscorea esculenta*) are followed with a sweet potato crop. Then in the third or fourth year, pitpit (*Saccharum edule*) cuttings are planted which marks the end of the planting cycle and the garden reverts to fallow. The garden continues to produce foods such as pitpit, bananas and pawpaw for several more years, until the fallow eventually takes over. With the planting of pitpit there is very little further maintenance work in the garden. Like old and overgrown cocoa blocks, visits to these older gardens are infrequent, and the brief harvesting visits are largely undertaken by women working alone. By this stage, men have redirected their labour to their younger, more productive gardens.

These examples suggest that the way people assess how much labour to commit to subsistence production has parallels with decision-making regarding the allocation of labour to cocoa production and the type of harvesting strategy employed (wet bean versus dry bean production). Declining yields of garden crops relative to labour inputs (due to the exhaustion of soil nutrients after a few years of cropping and the build up of weeds from the growing seed bank in the soil) initiates an incremental withdrawal of labour from garden maintenance and less frequent visits to the garden. The cultivation stage is replaced by a bush-foraging stage in which individual women intermittently visit the old garden to forage for foods in the fallow. In the case of cocoa, when a block reaches low productivity levels and does not meet the threshold quantity of accessible healthy ripe pods, labour inputs decline significantly. While the returns to labour may not be high enough to interest many men at this low productive stage, women still consider it worthwhile to harvest wet bean to earn small amounts of money (*kwik moni*) for immediate purchases, but they expend little labour in the process.

Whilst access to processing facilities is an important factor explaining why some households are predominantly wet or dry bean sellers, household income

strategies, access to labour and the quantity and accessibility of ripe fruit are all important determinants. The low density of ripe and easily accessible fruit of older and poorly maintained blocks reduces incentives to invest labour in the block, thus making a wet bean strategy more attractive than a dry bean strategy. Given the important influence of block condition on a household's cocoa harvesting and labour strategies (i.e. wet or dry bean), the following chapter examines block condition in more detail.

Chapter 7

Cocoa Farm Management Practices

This chapter examines cocoa farm management practices and describes some of the key features of block management that constrain smallholder productivity¹. The previous chapter argued that the quantity of healthy ripe pods influences the production strategy adopted by smallholders (wet bean or dry bean). This chapter examines how the quantity of healthy ripe pods is reduced by low levels of block maintenance. Poor block maintenance reduces the supply of easily accessible crop, which in turn undermines smallholder motivation to invest in block maintenance, thereby making a dry bean production strategy less viable.

We begin with an overview of smallholder block management including levels of pruning, shade control and weeding. This is followed by a discussion of pest and disease management and harvesting levels in which emphasis is given to the relationships amongst pruning and shade control, pest and disease levels, and growers' motivation to produce cocoa. The chapter also includes a discussion of some of the reasons for low labour inputs in block maintenance, such as inadequate levels of extension training and shortages of tools. These are not the full explanation, as the rest of the chapter makes clear.

Block Maintenance

A typical feature of most smallholder cocoa blocks surveyed was the very low levels of block maintenance, especially blocks more than eight or nine years old. In general, block maintenance was characterised by:

- Virtually no pruning of cocoa trees.
- Little or no shade control.
- Near adequate levels of weed control on relatively high producing younger blocks during cocoa flush periods.
- An absence of pest and disease control measures.
- Relatively high levels of under-harvesting.

Pruning, Shade Control and Weeding

Overall, there is minimal pruning of cocoa trees and very little shade control. There is usually some formation pruning of immature cocoa, but often this does not follow recommended procedures, suggesting that growers have not been trained in the correct techniques of pruning. Thereafter, pruning, if undertaken at all, is a very minor activity amongst most smallholders, and is more likely to

occur at the beginning of the flush period to enable easier access for harvesting. The time allocation studies revealed no pruning of cocoa trees and very little management of shade. Only two growers, on one occasion each, reported managing their shade trees. Both these growers had young stands of cocoa. Young cocoa stands are often inter-planted with food crops, and shade control is more likely to be carried out to promote food crop growth rather than cocoa production. Beyond the first two to three years of the establishment of a cocoa block, almost no labour is committed to pruning or shade control.

Like pruning, most weeding occurs when the cocoa block is young. Grass slashing is carried out regularly on newly planted cocoa blocks for two main reasons. First, most newly established cocoa blocks are interplanted with food crops and weeding is undertaken as part of general food garden maintenance. Second, most growers recognise that young cocoa trees are vulnerable to being over-shaded or choked by weeds and grasses when they are under 1.5 m tall². Whilst smallholders regularly slash undergrowth on newly planted blocks to enable young trees to become established, later grass slashing is largely at the beginning of cocoa flush periods to improve access for harvesting.

Our findings regarding pruning and weeding were reinforced by results from an assessment of 98 cocoa blocks at Tabaule and Vunalaing villages in the Livuan-Reimbar LLG area in December 2004 and January 2005 which revealed very low levels of block maintenance. While almost half of sample blocks were weeded (grass slashing) adequately or better, a substantial proportion were less than adequately pruned (76%) or managed for shade (72%) (Figure 7.1). The farm assessments found that most mature cocoa blocks (> 7 years of age) were characterised by tall and dense growth of cocoa trees with interlocking branches. These mature blocks were heavily shaded because of the long-term neglect of shade control.

Inadequate pruning of cocoa trees and lack of shade control leads to substantially reduced yields. Pruning of cocoa trees is known to stimulate flower development hence the potential yield is reduced by the lack of pruning. Excessive shade creates favourable conditions for pests and diseases leading to the early onset of yield decline. As Ghodake *et al.* point out:

Cocoa is a management-intensive crop. Neglect often results in irreparable damage and premature senility or death of the trees and renovation then is often difficult or impossible (1995, p.58).

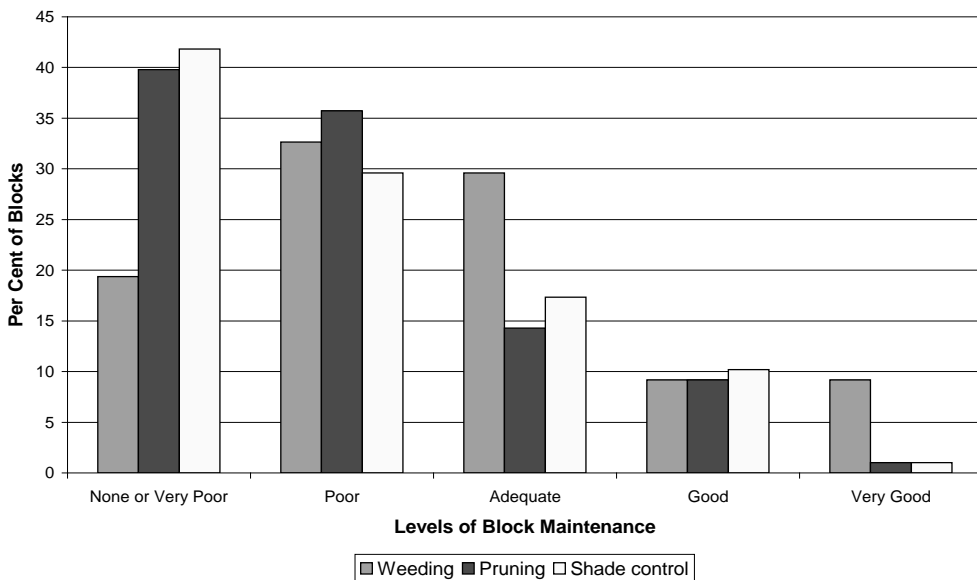


Figure 7.1. Levels of cocoa block maintenance in Tabaule and Vunalaiting villages.

Or as one former extension officer said more prosaically “cocoa is like a sick baby... it requires a lot of attention and care, otherwise it will die” (O. Putkin, pers. comm., 2004).

The assessment of cocoa block management distinguished between ‘on-block’ residence (cocoa blocks planted next to or near growers’ houses) and ‘off-block’ residence (cocoa blocks at a distance from growers’ homes). It was anticipated that on-block residence would be associated with better block maintenance because growers would have more opportunities to work on cocoa blocks close to their houses. Levels of pruning and shade control were not strongly associated with on-block residence. Pruning levels were worse on blocks where growers resided, with pruning on 77% of blocks rated as ‘poor’, ‘very poor’ or ‘none’, compared with 73% of cocoa blocks at a distance from growers’ residences (Figure 7.2).

The difference was attributable to the older age of cocoa stands near to where growers live (mean difference in age of blocks is 3.6 years): the oldest blocks were planted closer to growers' homes, while more recently planted cocoa blocks were established further away (see below).

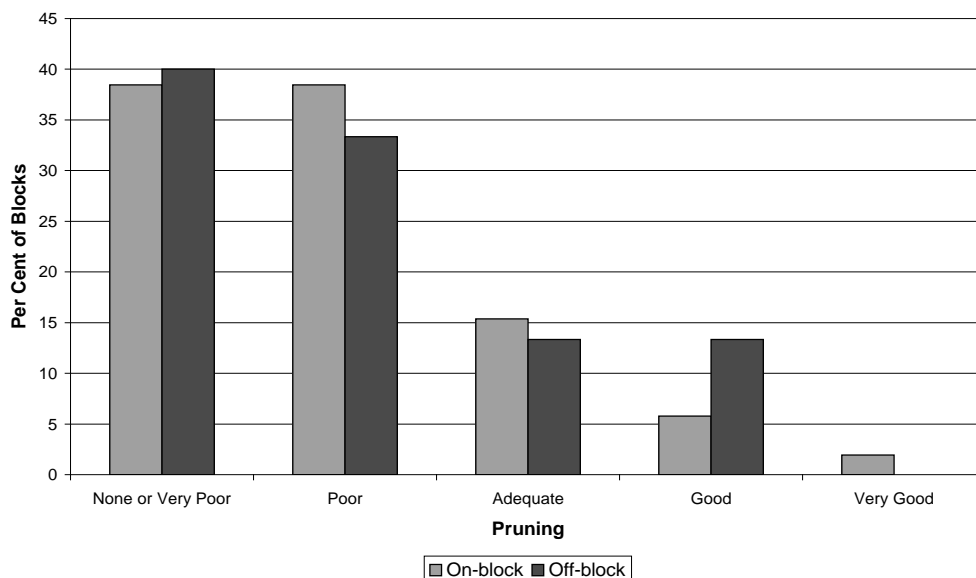


Figure 7.2. Cocoa pruning standards for on-block and off-block grower residence in Tabuale and Vunalaiting villages.

While on-block and off-block differences were not marked for shade control, cocoa blocks at a distance from growers' residences had, as would be anticipated, lower standards of shade control than blocks where growers resided. Seventy-five per cent of cocoa stands with off-block residence rated 'poor', 'very poor' or 'none' for shade control compared with 67% of blocks with on-block residence (Figure 7.3). The better shade management on cocoa stands with on-block residence may be to let more light through to highly valued fruit trees, kitchen gardens or simply to create a more congenial environment (more light and less mosquitoes) around the house site. Shade management was not undertaken specifically to improve cocoa production.

Whilst on-block residence was not strongly associated with pruning and shade control — because of very low levels of pruning and shade control overall — weeding was considerably better on cocoa blocks near the grower's residence.

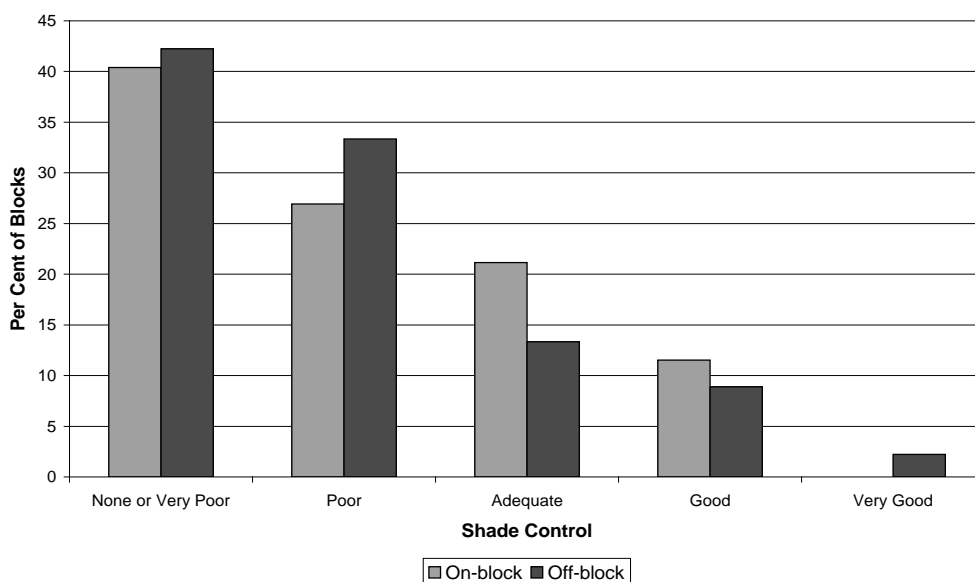


Figure 7.3. Shade control standards for on-block and off-block grower residence in Tabaule and Vunalaing villages.

For weeding, 56% of cocoa blocks with on-block residence were rated as ‘adequate’ compared with 38% of cocoa stands with off-block residence (Figure 7.4). While on-block residence provides more frequent opportunities to weed, there is also the ‘pride’ factor, in that people who have tall and unkempt grasses or weeds in the vicinity of their homes are considered lazy. Keeping the areas around houses clear of weeds and grasses is socially responsible behaviour because it reduces levels of mosquitoes, and makes for a safer living environment (less snakes and dangerous insects like centipedes). While the pride factor motivating weeding is perhaps less strong for blocks further away from the house, these more distant stands, if the trees are not too tall and overgrown, may be weeded at the beginning of the cocoa flush period. As stated previously, this is not for reasons of block sanitation or for more productive cocoa trees, but to improve access for harvesting.

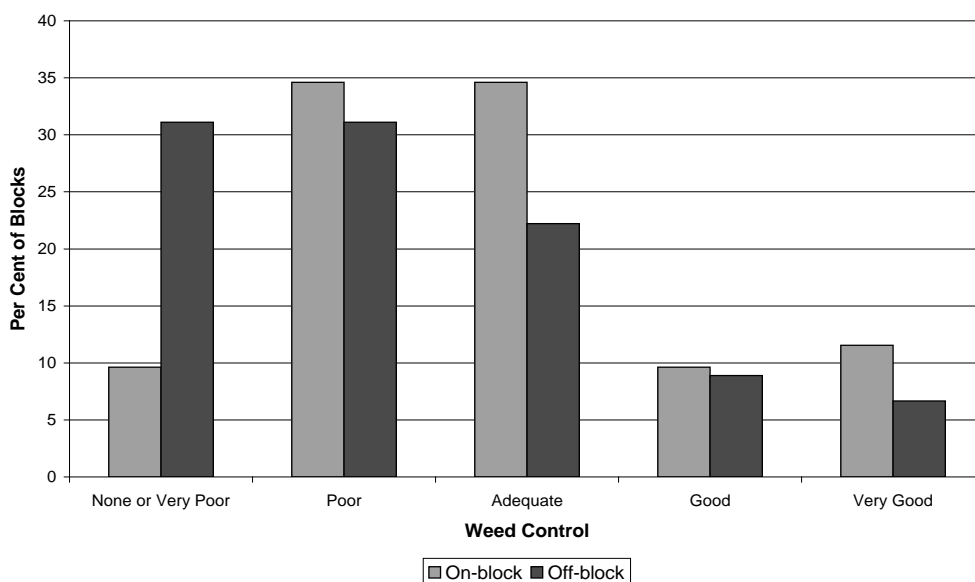


Figure 7.4. Weed control standards for on-block and off-block grower residence in Tabaule and Vunalaing villages.

Pest and Disease Control

Our assessments indicated that pest and disease management practices were minimal (Figure 7.5). Management of pests and diseases was rated as ‘poor’ or ‘very poor’ for 80% of blocks, and none had undertaken spraying. Further, whether or not growers resided on their cocoa blocks appeared to have little influence on levels of pest and disease control (Figures 7.6 and 7.7), though off-block residence was associated with marginally better levels of control. It must be remembered that while age differences in cocoa stands may explain the slightly better standards of pest and disease control on cocoa blocks with off-block residence, overall levels of pest and disease control were very low, irrespective of whether growers lived on or off their blocks.

Low levels of pest and disease control were also evident in the weekly surveys. Some growers said they removed black pods from the branches during harvesting and the diseased pods were left where they fell on the ground. Only one grower reported visiting his block specifically to remove diseased pods. Another grower recalled using a technique whereby leaves from a certain tree were heaped and set alight under a cocoa tree infected with Black Pod. He believed the smoke would ‘kill’ the sickness affecting the pods. None of the households had used chemical sprays for pest control. These findings concur with other studies on smallholder cocoa production in PNG that show the

recommended control measures are rarely applied to manage cocoa pests and diseases (e.g., Nicholls, 1989; Yarbrow & Noble, 1989; George, 1994; Ghodake *et al.*, 1995; Omuru *et al.*, 2001).

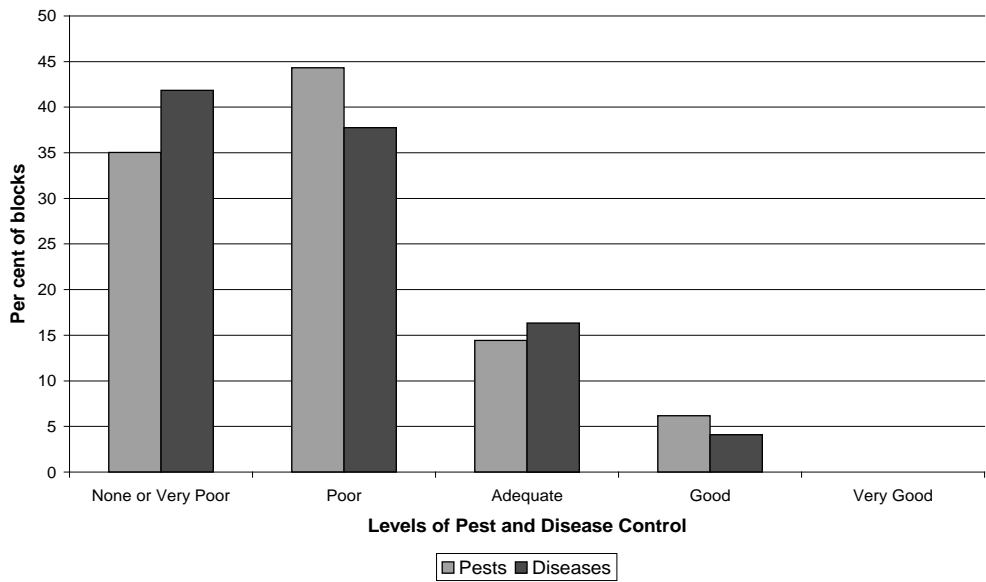


Figure 7.5. Control levels for pests and diseases in Tabaule and Vunalaing villages.

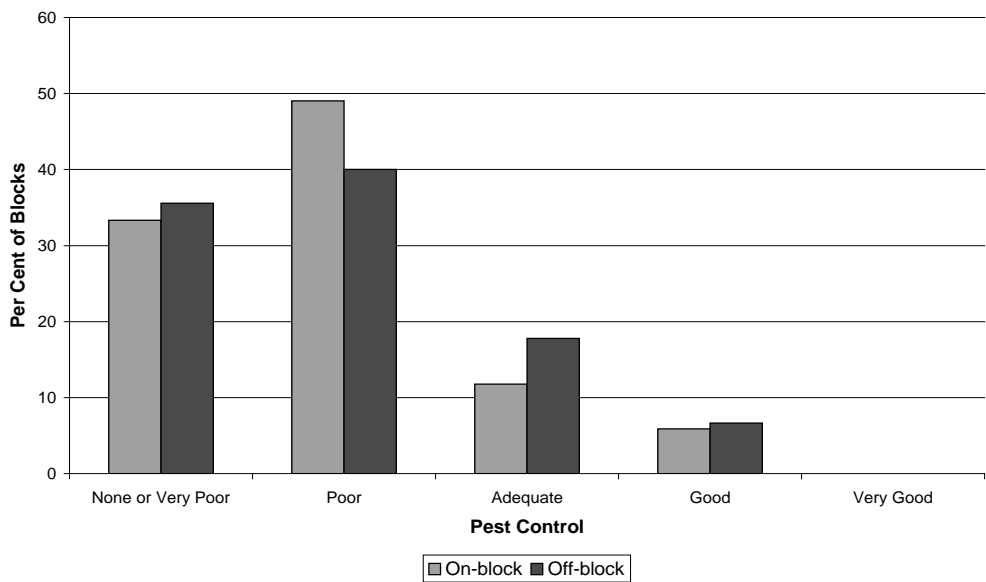


Figure 7.6. Control standards for cocoa pests for on-block and off-block grower residence in Tabaule and Vunalaing villages.

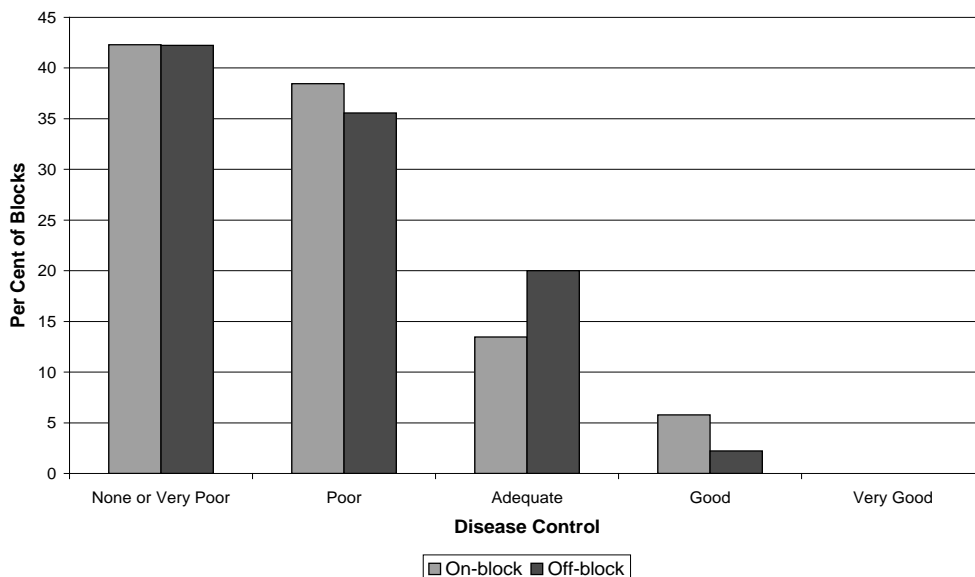


Figure 7.7. Control standards for cocoa diseases for on-block and off-block grower residence in Tabaule and Vunalaing villages.

Despite the low levels of pest and disease control measures, there was widespread recognition amongst smallholders of the extent of losses caused by pests and diseases like Black Pod and Canker. Fifteen per cent of cocoa farmers in the socio-economic survey cited pest and disease losses as one of the key reasons for a contraction of their cocoa holdings over the past five years, and 33% of growers identified pest and disease problems as the chief constraint on production. Similarly, Omuru *et al.* (2001) reported 82% and 73% of ENB farmers identified cocoa pests and diseases respectively as the most important factors limiting cocoa production. This issue is explored further in Chapter 8 in relation to household labour strategies.

Pest and Disease Rates

The low levels of block maintenance together with minimal pest and disease management were reflected in the high rates of pests and diseases recorded in the cocoa block assessments (Figure 7.8). Two major diseases of cocoa in PNG — Vascular Streak Disease (VSD) and Canker — were common, with only 8% and 26% of trees respectively being free of these diseases (Pink Disease was absent on 96% of surveyed trees).

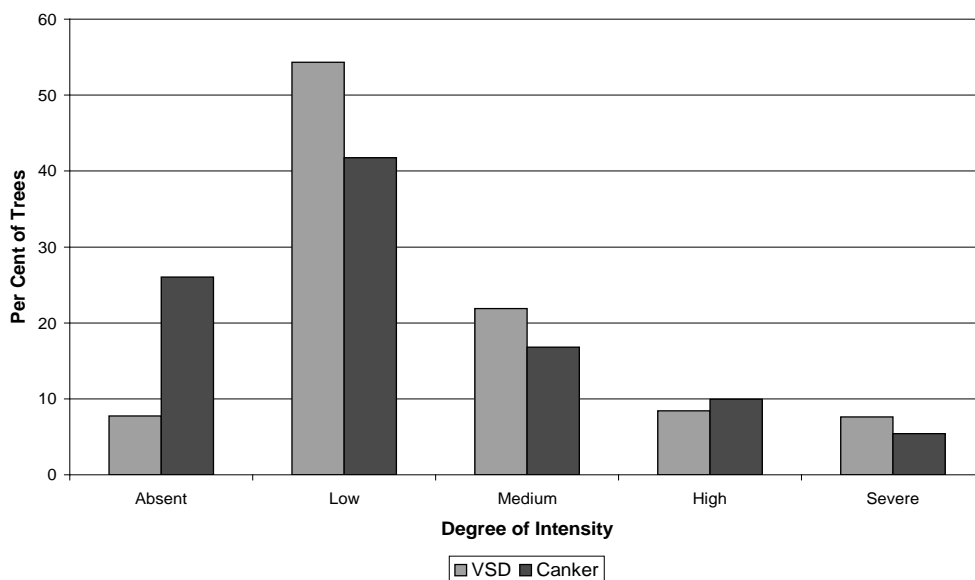


Figure 7.8. Degree of intensity of infestations of Vascular Streak Disease and Canker in Tabuale and Vunalaing villages.

On-block residence was associated with lower rates of Canker and VSD (Figure 7.9), particularly canker. The lower Canker rate was probably attributable to the higher rate of weed slashing around house sites (see Figure 7.4). Canker often affects the lower trunk of the tree where borers such as the cocoa weevil borer (*Pantorhytes biplagiatus*) and Longicorn larvae burrow under the bark allowing the Canker fungus to enter the tree. These borers can also ringbark the tree (Plate 7.1). The higher rates of weeding keep the trunk free of grasses, thus reducing cover for *Pantorhytes* weevils and Longicorn beetles. Slashing also keeps the bark drier and harder and thus less penetrable to these borers.

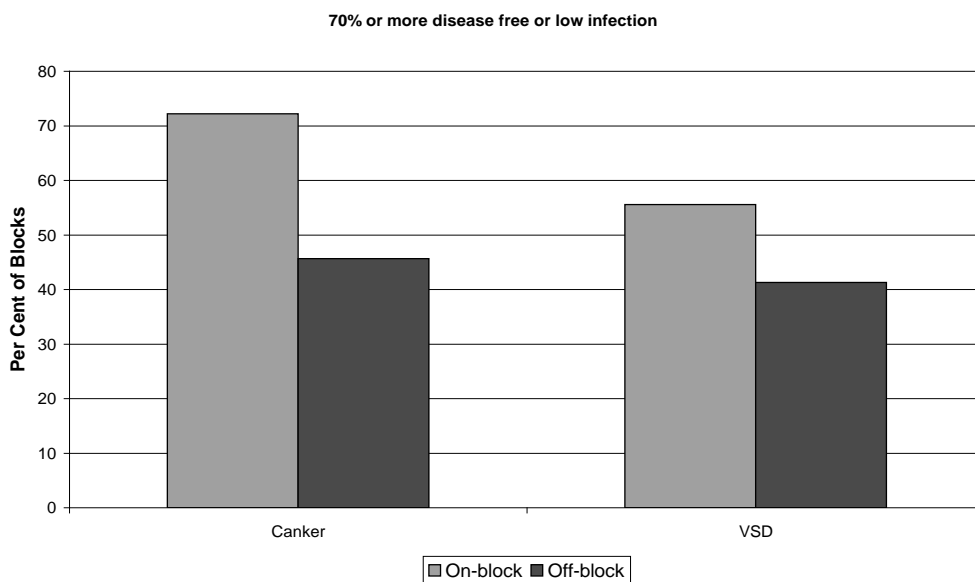


Figure 7.9. Canker and VSD infection rates for cocoa on-block and off-block grower residence in Tabaule and Vunalaing villages.



Plate 7.1 Ringbarking of main trunk caused by Longicorn larvae.

The lower rate of VSD associated with on-block residence is more difficult to explain. It may reflect slightly better block sanitation associated with the higher grass slashing rates, or it may simply reflect people spending more time on cocoa blocks nearer to where they reside. The symptoms of VSD are very visible³ and some growers may remove infected branches if they recognise it as a potential problem. Blocks further away from growers' houses are typically only visited for harvesting, and there are fewer opportunities to remove infected branches.

Rates of *Phytophthora* infected pods (Black Pod) were relatively low at 6% of the total number of full size pods⁴ (Table 7.1). Cocoa blocks with on-block residence had marginally higher rates of *Phytophthora* infected pods than off-block residence cocoa blocks. One might expect on-block residence to be associated with reduced incidence of diseased pods because of higher levels of overall care and maintenance for the cocoa blocks where growers live. It is probable that weeding and grass slashing are greater on cocoa blocks where growers reside (e.g., weeding and grass slashing) (see Figure 7.4). However, the effect of increased and more regular inputs of labour is likely to be masked by the age difference between the two groups of blocks. Cocoa stands near farmers' houses were on average 3.6 years older than cocoa stands at a distance from growers' residences. The marginally higher rates of *Phytophthora* infected pods on cocoa blocks with on-block residence may be explained by the greater age of these cocoa stands, giving a longer period for the build-up of inoculant. Moreover, the non-removal of infected pods from cocoa trees together with high rates of under-harvesting (see below), enlarges the reservoir of disease inoculant thereby sustaining high infection rates (Plate 7.2).

Table 7.1. Percentages of mature pods identified as Black Pod (*Phytophthora*), Dry Pod and Healthy Pods by location of growers' residence.

House Location	Black Pod (<i>Phytophthora</i>)	Dry Pod	Healthy Pod
On-block	6.0	30.5	63.5
Off-block	4.6	26.1	69.3
All blocks	5.3	28.6	66.1



Plate 7.2. Symptoms of Black Pod (*Phytophthora*) infected pods on a smallholder block. This infected pod was at waist height in the tree and next to the main track to the grower's house. Only a small minority of growers remove infected pods.

Finally, long-term minimal pruning and shade control on older blocks exacerbates pest and disease problems by creating a moist micro-climate conducive to outbreaks of Black Pod and other pests and diseases (Konam, 1999). Any spatial effect of increased pest and disease rates on more distant cocoa blocks is masked by the greater age of cocoa stands on blocks where growers reside. The influence of the age of the cocoa stand on block maintenance standards (e.g., pruning and shade control) and pest and disease rates was also noted by Ghodake *et al.* (1995) on the Gazelle Peninsula. The authors found that 80% and 69% of *Phytophthora* and VSD infestations, respectively, were located in 'mature cocoa' where block management conditions were much poorer than in younger cocoa stands.

Harvesting Rates

While production losses due to pests and diseases are important factors explaining low productivity, another major factor is under-harvesting, particularly on older cocoa blocks. Dry pods are evidence of under-harvesting in the previous four month period. When ripe pods are not harvested they dry out and can remain for up to 18 weeks on the tree before disintegrating (J. Konam, CCI, pers. comm., 2004).

Despite the possibility that some Black Pods were incorrectly identified as dry pod⁴ during the survey, under-harvesting is clearly a significant problem. Dry pods made up 29% of the total number of full size pods on the trees sampled. The rate was slightly higher for on-block residence, reflecting the greater age and height of these trees which makes harvesting more difficult (Table 7.1). There was also evidence of an edge-effect in which the ratio of dry pods to mature healthy pods increased from 24% of total full size pods at the roadside edge of the block (or from the family home on the block) to around 34% at 40 m to 50 m into the block⁵. While the height in the tree of dry pods was not noted in the survey, observations indicated that dry pods were more common in the upper canopy where harvesting is more difficult and time-consuming, thereby implicating labour supply constraints in its incidence and distribution. The high levels of under-harvesting represent a considerable loss of smallholder production and income. Moreover, the high levels of under-harvesting of mature pods in the upper canopy increase the likelihood of disease in the cocoa block.

Explaining Low Levels of Block Maintenance

High rates of pests and diseases severely reduce smallholder productivity and incomes (Ghodake *et al.*, 1995; Drenth & Sendall, 2004). High rates of pests and disease (and the consequent low yields) are themselves an outcome of very low levels of labour invested in block maintenance. The question remains as to why most smallholders do not undertake even basic pruning and shade control? The answer lies in a combination of factors including limited knowledge of appropriate farm management practices, few or inappropriate tools for block maintenance and harvesting, and the vegetation structure of the block (a function of the age of the block and shade level) which affects accessibility for harvesting and the supply of labour for all of these tasks.

The following discussion considers the role of tools and agricultural extension and training in smallholder management practices. In the next chapter we examine how the developmental stage of a cocoa stand influences how family labour is deployed in cocoa production.

Farm Tools

A shortage of tools is almost certainly a contributing factor to low levels of block maintenance. Figure 7.10 compares household ownership of tools on the Gazelle Peninsula with households in three villages near the Stockholm plantation group in the Bainings where NGIP-Newmark is working in

partnership with cocoa smallholders to raise their productivity and incomes. NGIP-Newmark is providing smallholders with extension training, hybrid cocoa seedlings and clones, and tools on credit. These smallholders are amongst the highest producing smallholder cocoa growers in PNG (G. McNally, NGIP-Newmark, pers. comm., 2004).

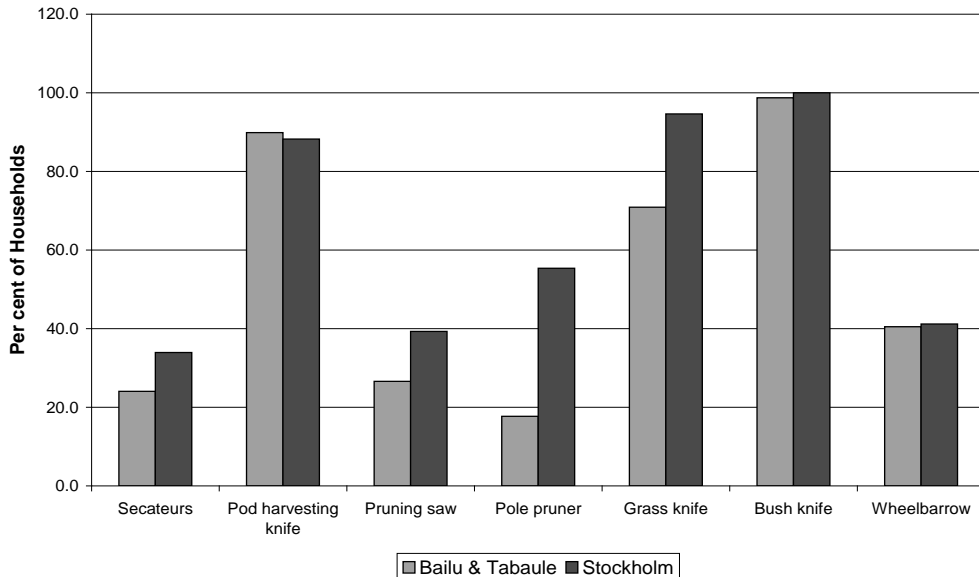


Figure 7.10. Rates of ownership of tools amongst village households in Kokopo-Vunamami and Livuan-Reimbar LLG areas compared with village households near the Stockholm plantation group in the Bainings, ENB.

Smallholders on the Gazelle Peninsula and at Stockholm have similar rates of ownership for some tools, such as harvesting knives (hook knives) and wheelbarrows. But households on the Gazelle Peninsula have fewer tools for block maintenance, particularly for pruning and shade control (e.g. secateurs, pruning saws, and pole pruners for cutting high branches) (Figure 7.10). On some blocks on the Gazelle Peninsula there was visible evidence of damage to cocoa trees as a result of bush knives being used to cut branches (to improve access for harvesting), thereby raising risks of tree infection.

While almost 90% of households on the Gazelle Peninsula reported possessing a cocoa knife for harvesting pods, many harvesters used bush knives, and some harvesters were observed tearing the pods from trees during harvesting (Plates 7.3 and 7.4). This damages the cushion on the trunk from which new flowers emerge and heightens the risk of disease infection, thereby reducing the long-

term productive potential of the tree. When the damaging effects of this harvesting practice were pointed out to farmers by extension officers, farmers said they were unaware of the potential loss of future production and increased risk of infection.



Plate 7.3. Cocoa pod harvested by ripping it from the tree. Note the section of bark that came away with the pod.



Plate 7.4. A flower cushion damaged by tearing the pod from the tree during harvesting.

Tool shortages may have a direct bearing on block condition in several ways. First, use of the correct tools will increase labour efficiency. Second, farmers who use the incorrect tools (e.g. bush knives for pruning) risk damaging their trees and introducing infections (although any pruning is better than no pruning). Third, adequate pruning and shade control will reduce the incidence of pests and diseases and increase yields. This is important because when the availability of accessible, healthy ripe pods increases farmers will increase the size of their labour groups for harvesting (e.g. during flush periods) and commit more labour to grass slashing. The effective promotion of tools amongst smallholders, together with adequate training in their use, would raise labour effectiveness in farm management and lead to improved yields.

Extension Training

Many smallholders continue to place importance on the role of extension training for maintaining good production and perceive a need for more regular extension training and advice to improve block management techniques. Their concerns regarding extension are reflected in the following selection of smallholder comments noted during the socio-economic survey of farmers in the Kokopo-Vunamami and Livuan-Reimbar LLG villages:

[Farmers] need extension workers to advise them on both hybrid cocoa and hybrid cocoa clone management.

Extension officers... should teach the farmers [about] cocoa block management.

Extension is needed in the rural areas to train especially the youth in cocoa work.

The farmer really needs help from the extension officers on pest and disease control.

Extension officers should visit farmers in their wards to help farmers in pruning or even to manage cocoa blocks.

It will be good to have the extension officers visit us to give advice on the new hybrid cocoa clones, as well as the pests and diseases of cocoa.

The inappropriate farm management practices observed during this study also confirm that more farmer training is necessary to improve smallholder production. In the study areas only about one third of farmers received extension training or advice during the twelve months preceding the study⁶ (Table 7.2).

Table 7.2. Percentages of growers who said they received some extension advice within the previous 12 months.*

Topic	Kokopo-Vunamami LLG (%)	Reimbar-Livuan LLG (%)	Mean (%)
New hybrid clones	39.5	10.0	24.4
Cocoa redevelopment	44.7	12.5	28.2
Pruning	44.7	20.0	32.1
Pest & disease control	34.2	15.0	24.4
Shade control	42.1	17.5	29.5
Weed control	44.7	22.5	33.3
Cocoa management	52.6	20.0	36.3

* Extension advice included formal or informal training from a government extension worker, attendance at a field day or a visit to CCI or another agricultural station

The relatively low level of training and advice on the management of the new hybrid clones (Table 7.2) means that the high yield potential of this new clonal material may not be realised because they require different management and pruning techniques from earlier cocoa material. The new clones require specific pruning techniques when young to ensure high yields when mature. For example, CCI recommends tipping at 4-6 months after planting, followed by formation pruning at around three months after tipping⁷. Light pruning should then follow every 3-4 months until the canopy closes. Without this advice, smallholders will undoubtedly apply inappropriate management practices to their newly planted hybrid clones.

The experiences of extension officers reveal that providing extension advice and training to smallholders does not guarantee that the advice will be incorporated into their repertoire of cocoa management practices⁸. During this study, extension officers often voiced their frustration at providing training to farmers only to see a small minority of farmers apply their newly acquired skills and techniques. The problem is compounded by the fact that few growers have the appropriate tools to manage their blocks effectively. In addition, despite the recognition among smallholders of the debilitating effects of pests and diseases on production, very few growers have adopted control measures.

While efforts to increase agricultural extension and training would undoubtedly raise smallholder productivity it would be unrealistic to expect that such efforts on their own will solve the problem of low smallholder productivity. This is firstly because of the low uptake of advice and secondly because of a set of complex factors that lead to underharvesting and low levels of investment in block maintenance. These factors include:

- the amount of ripe accessible fruit available for harvesting;
- labour shortages and the under-utilisation of available labour;
- the relative importance of cocoa income to other sources of household income;
- whether a household is predominantly a wet bean or dry bean seller;
- the distribution of cocoa income within the family;
- the practice among some growers of planting new areas of cocoa rather than investing time and labour in rehabilitating their unproductive older cocoa blocks;
- high levels of pests and diseases;
- high rates of under-harvesting;
- shortages of tools;
- the development stage of the cocoa block.

The next chapter brings these factors together in a simple model of production that illustrates how these factors work together to influence smallholder productivity at different stages in the life cycle of a cocoa block.

Chapter 8

A Model of Smallholder Production

The last three chapters revealed that smallholder cocoa production strategies are determined by a complex set of interconnected factors encompassing household livelihood strategies, the distribution of household income, labour supply, pests and diseases and block condition. Smallholders identified the top four constraints on cocoa production in declining order of importance as:

- theft of cocoa pods (sometimes an indication of under-harvesting);
- poor block condition (overgrown cocoa trees, over-shading and high levels of pests and diseases);
- labour shortages; and
- poor knowledge of proper management practices, especially regarding new hybrid cocoa clones.

This chapter explores the inter-relationships among livelihood strategies, household income distribution, labour supply and block condition using a simple model that relates the key characteristics of smallholder production to the three different development stages of the typical smallholder cocoa block. The model of smallholder production presented here highlights the relationships between the age of a cocoa block (and hence its vegetational structure), pest and disease levels, yields, household labour inputs and production strategies. It provides a conceptual framework for understanding smallholder productivity that can be used to develop interventions in partnership with smallholders to raise productivity and incomes. Policy interventions are discussed in Chapter 9.

Model of Smallholder Production

The model of smallholder production depicted in Figures 8.1a to 8.1f, reveals that the age of a cocoa block is a key determinant of block condition including vegetation structure, degree of shading and levels of infestations with pests and diseases. Because the typical smallholder cocoa block receives little or no pruning and shade control, and there is virtually no management of pests and diseases, the condition of a block is largely a function of its age. Further, the deteriorating condition of the block with age means that under-harvesting can become a significant problem on older cocoa blocks. The age of a cocoa stand influences labour inputs through the particular harvesting/production strategies pursued by households.

The model is based on three development stages of the cocoa block: immature; mature; and, senile (Figure 8.1a). Each stage has associated with it a distinctive set of structural characteristics of the vegetation:

- Stage 1 Immature: < 3 years (low production and low pest and disease levels).
- Stage 2 Mature: 3-8 years (high production and rising pest and disease levels).
- Stage 3 Senile: 7-8 + years (low production and high pest and disease levels).

Each development stage also has its own distinct characteristics in terms of the following:

1. levels of pests and diseases (Figure 8.1b);
2. labour inputs (Figure 8.1c);
3. the degree of accessibility for harvesting (Figure 8.1d);
4. the quantity of healthy, ripe crop available for harvesting (Figure 8.1d);
5. harvesting and production strategies employed by smallholders (wet or dry bean production) (Figures 8.1e and Figure 8.1f).

The three development stages of a cocoa block may vary by cocoa variety and the timing of the transition between stages. They can also be modified by a range of other production factors such as labour shortages (see Chapter 6), climate variability (poor flush period) or access to or disputes over land (Chapter 4). Each stage is discussed below.

Stage 1 Immature

In the young cocoa stand, there is open space between the trees and they are not overshadowed by the most commonly planted shade tree, *Gliricidia*. Most of the crop is harvested because of easy accessibility (open space between trees and short trees) and a high proportion of ripe pods are disease free. The small number of cocoa pods per tree usually means the crop is sold as wet bean. These small wet bean harvests are usually carried out by one or two individual family members working alone or together. As shown in Table 6.2 (Chapter 6), most wet bean harvesting is undertaken by women and children. Although dry bean production is less common on Stage 1 blocks, some growers with large holdings of Stage 1 cocoa or access to an additional cocoa holding with relatively good yields (e.g., a Stage 2 cocoa block), may harvest sufficient quantities of ripe pods to make it worthwhile to process their beans¹.

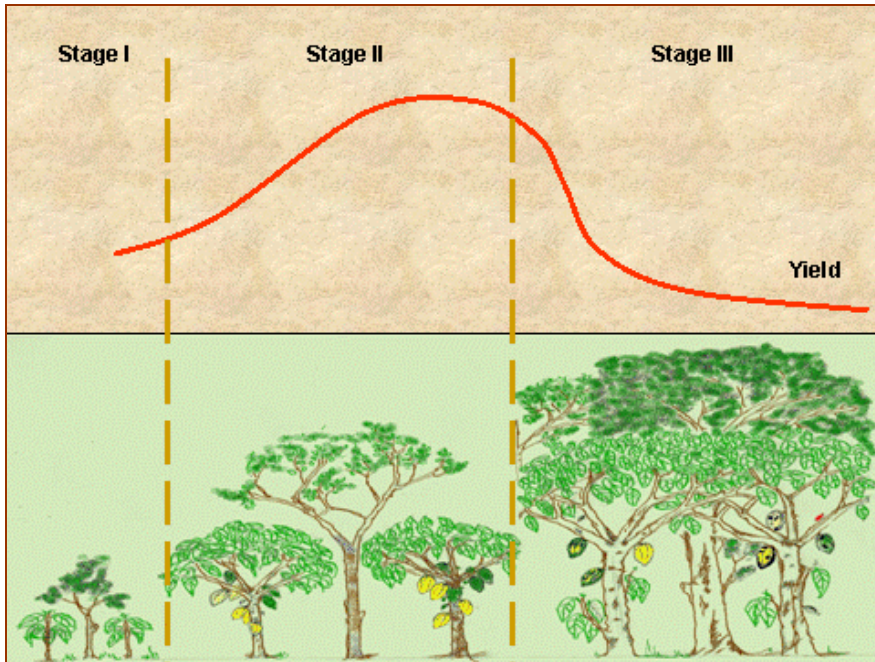


Figure 8.1a. Yield profile associated with the three stage model of smallholder production.

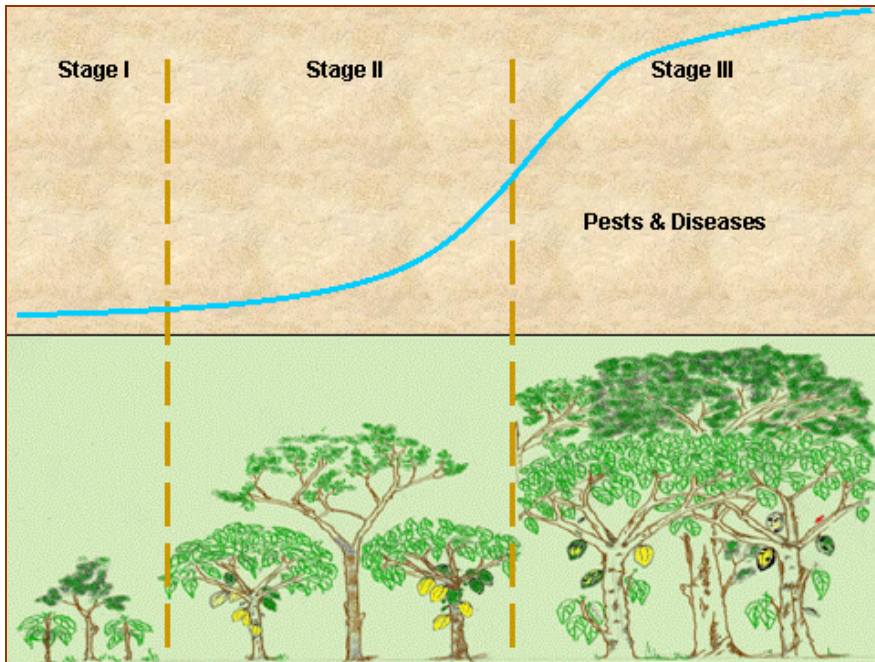


Figure 8.1b. Pest and disease profile associated with the three stage model of smallholder production.

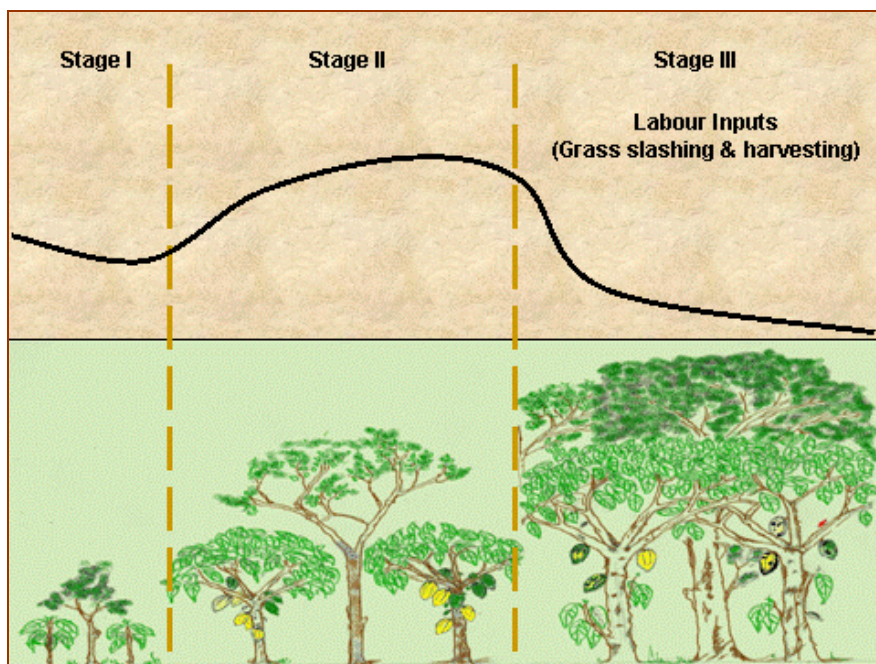


Figure 8.1c. Labour input profile associated with the three stage model of smallholder production.

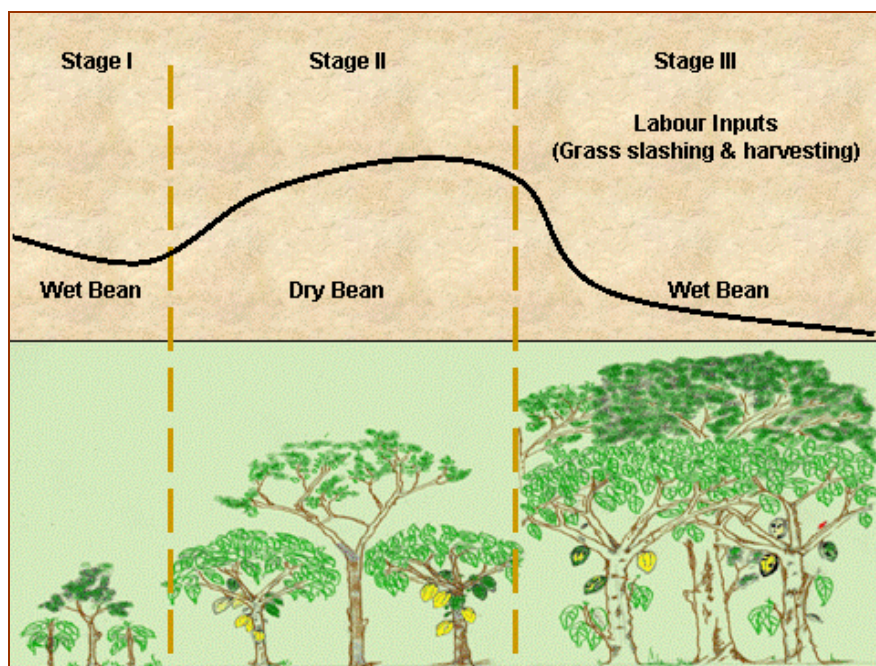


Figure 8.1d. Production strategy profile associated with the three stage model of smallholder production.

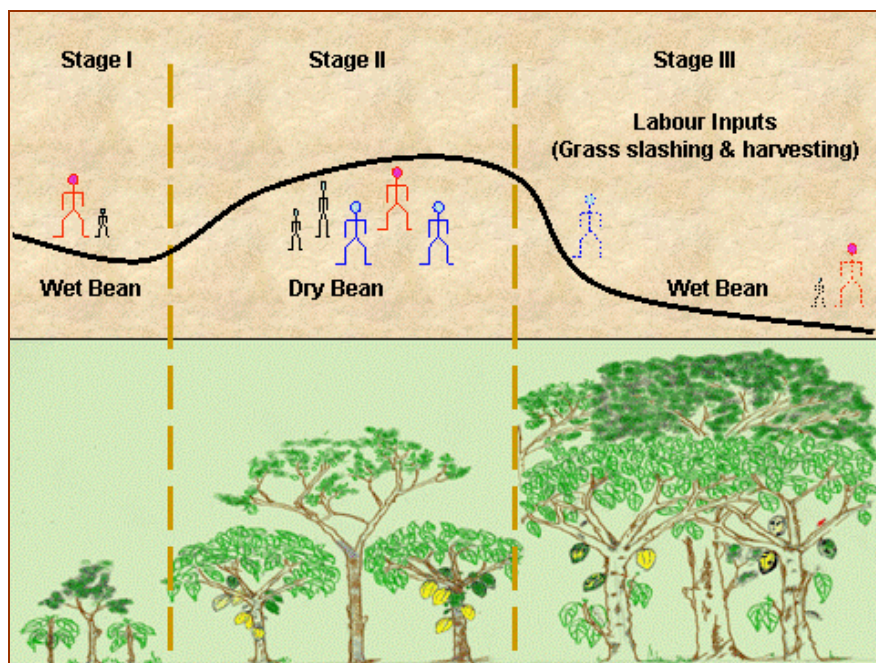


Figure 8.1e. Labour input and harvesting strategy profile associated with the three stage model of smallholder production.

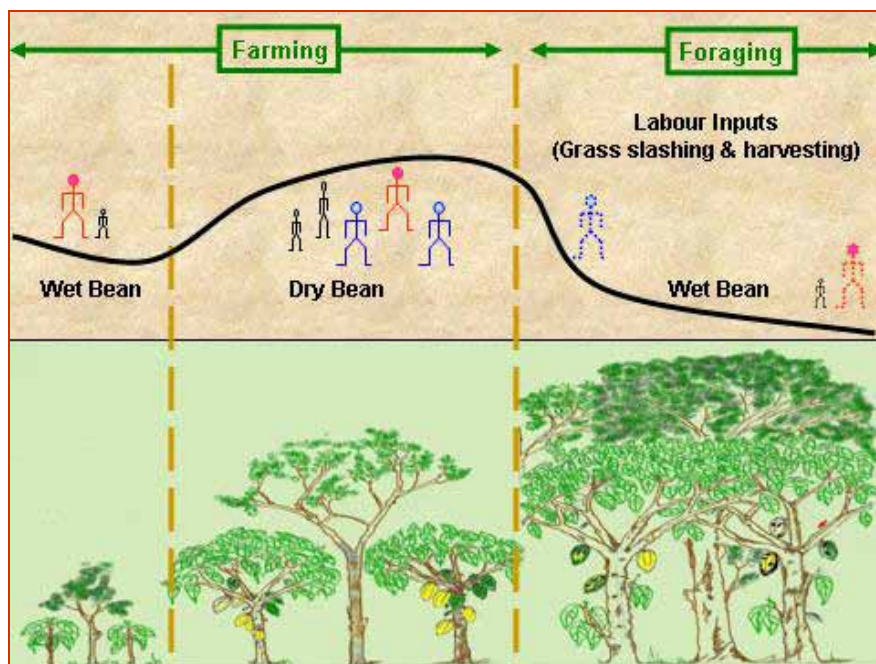


Figure 8.1f. Farming and foraging phases associated with the three stage model of smallholder production.

Cocoa stands at Stage 1 show promising potential for future production and income levels because they are more likely to be the latest planting material distributed by CCI. During Stage 1, production is rising as the trees mature, and growers show an interest in grass cutting. While many farmers recognise that young cocoa trees are easily choked by weeds and grasses and therefore must be weeded regularly, the onset of pod development and harvesting encourages farmers to invest more time and labour in these blocks. As CCI's on-farm trials have revealed, farmers managing precocious hybrid clones that bear fruit at 18 months commence block maintenance (grass slashing) earlier and visit their blocks more regularly than farmers managing later fruiting hybrids (David Yinil, CCI, pers. comm., November, 2004).

Furthermore, because most growers interplant young cocoa with food crops such as bananas, cassava, peanuts, or other fruit trees, the cocoa block is visited more frequently than older blocks where the shade canopy precludes cultivation of food crops. The practice of intercropping cocoa with food crops was observed on the Gazelle Peninsula as early as 1976 by Bourke who noted "[t]he farming systems have been modified so that food crop production can be phased into cash cropping, particularly with cocoa" (p. 96). Ghodake *et al.* (1995) also found that the majority of recently planted cocoa blocks surveyed in their study on the Gazelle Peninsula were hybrid cocoa interplanted with food crops. They also reported that block management was "fair to very good" on 81% of these blocks (p. 60), although inadequate shade control was a problem on most blocks.

Both the planting of early producing cocoa varieties and the interplanting of young cocoa with food crops encourages growers to visit their Stage 1 blocks more frequently and perform maintenance like weeding. Because the cocoa income from Stage 1 blocks is low (but rising), these growers depend on alternative income sources such as other cash crops or the income earned at local markets by female members of the household. As yields of cocoa rise, the family's dependence on other income sources diminishes and cocoa becomes the focus of cash earning activities. At this stage, farmers show interest in their block and anticipate good future returns from their labour.

Stage 2 Mature

During the mature, productive stage (3-8 years) the trees are larger, but not so tall that harvesting the upper branches is difficult. There is still open space between the trees, making for relatively unimpeded access for harvesting, and some intercropping with food crops continues in the early years of Stage 2.

Because the block is not overgrown nor too heavily shaded, pest and disease levels are tolerable and not yet affecting crop yields significantly (Figure 8.1b). Relatively high crop yields continue to encourage growers to slash weeds and grasses to improve access for harvesting. However, pruning, shade management, pest and disease control and other tasks necessary for maintaining the block in good condition are generally not undertaken.

The large amount of ripe, healthy crop available for harvesting is associated with a shift in production strategies. Households shift from wet bean selling, typical of Stage 1, to dry bean processing (Figure 8.1d). At Stage 2 a high proportion of the crop is sold as dry bean, thereby generating better returns for smallholders (families without processing facilities are often able to access those of relatives). The larger quantity of crop available for harvesting also requires larger harvesting groups, and more men are usually involved in harvesting. Harvesting groups tend to be large family groups of men, women and children working together (Table 6.2, Chapter 6).

If the quantity of ripe cocoa available for harvesting is sufficiently large, family harvesting groups may be augmented with labour recruited from the extended family, and, very occasionally by the employment of hired labour. Co-operative work groups made up of the extended family and/or village groups often form at the beginning of the cocoa flush to slash undergrowth to improve access for harvesting. Sometimes these co-operative work groups operate as reciprocal labour groups (*varvarmal*), where each nuclear family's cocoa block is cleared of undergrowth in turn by the co-operative group (see Chapter 6). Hired labour may be employed for grass slashing, but this tends to be limited to those farmers with a more business-focused approach to cocoa production, and this type of grower is in a minority.

While most of the crop is processed and sold as dry bean, small amounts of wet bean may continue to be sold. Many women, although participating in family harvesting for dry bean production in Stage 2, continue to harvest and sell small quantities of wet bean. These small sales of wet bean supplement women's income from local markets, with the income spent immediately on basic household items such as store foods.

The more cooperative household labour strategies associated with Stage 2 cocoa blocks (and dry bean production generally) rely on the skills of the male household head to recruit and manage family labour (Chapter 6). A common strategy for facilitating access to labour from the family or extended family is

for the male household head (the father) to allocate harvest rounds, usually during flush periods, to co-resident married sons or daughters, or to relatives needing cash². The individual allocated the harvest round will recruit and manage the necessary labour and take responsibility for processing and marketing the cocoa, and distributing the income.

By allocating harvest rounds to immediate family and other relatives, the father ensures the supply of labour for harvesting (and often grass slashing) is adequate for maintaining high harvesting rates during Stage 2 production. The allocation of harvest rounds creates an obligation amongst those granted harvest rounds to reciprocate by providing labour for cocoa and subsistence tasks. Also, because of the high density and easy accessibility of healthy, ripe pods during cocoa flushes in Stage 2 blocks, labour recruitment is easier than for older, Stage 3 blocks. Some household heads lack the status or skills to manage reciprocal labour arrangements, and therefore find it difficult to shift from wet bean sales (associated with Stage 1) to the Stage 2 dry bean production strategy that requires larger work groups.

Stage 2 cocoa blocks can return relatively good incomes to smallholders. During flush periods, cocoa is likely to be the dominant household economic activity and source of income. But while income levels are relatively high, very little of that income is reinvested in block maintenance (Chapter 5, see also Omuru *et al.*, 2001). Further, because of the absence of pruning and shade control, the increased flowering rate in response to effective pruning and shade control does not occur. Towards the later years of Stage 2, pest and disease levels begin to rise sharply, leading to falling yields. As the blocks become overgrown, accessibility declines, and it becomes progressively more difficult to harvest. Farmers begin to lose interest in their cocoa block

Stage 3 Senile

Stage 3 (>7-8 years) is the least productive stage in the life cycle of the cocoa block. At this stage, the vegetation is dense and the block is overgrown (Figure 8.1a). There is no open space between the cocoa trees because the branches interlock those of neighbouring trees, and the shade cover is dense. Block maintenance is virtually abandoned. The amount of healthy ripe crop that is easily accessible for harvesting falls to very low levels because of the high proportion of diseased pods and the difficulty of harvesting pods in the dense vegetation or high in the canopy. Incentives to invest labour in block maintenance and harvesting decline to very low levels.

When a cocoa stand enters Stage 3, income from the block declines rapidly to low levels, and dry bean production ceases (Figure 8.1d). Cooperative household work groups are disbanded and production strategies revert to those similar to Stage 1 development, that is, very small quantities of cocoa harvested by women working alone or with young children. During Stage 3, the small quantities of cocoa harvested are sold as wet bean and production is driven by short-term needs. Typically, families use their Stage 3 cocoa blocks like bank ATMs: the cocoa block is visited only when cash is required for immediate consumption (e.g., church donations or small store purchases such as soap, kerosene, or food for the evening meal). Growers call this type of income ‘*kwik moni*’ because the income is earned quickly and with little effort. Block visits rarely involve more than a few hours of harvesting during which time one or two baskets of wet beans are collected and sold (average harvest 17.7 kg — see Table 6.2). Very little or no time is allocated to block maintenance (Figure 8.1e). This type of production practice is known as ‘forage harvesting’. Male farmers have lost almost all interest in their cocoa block as it enters the Stage 3 senile phase.

Associated with the transition to a Stage 3 cocoa block is the diversion of family labour to more lucrative income sources, such as to the family’s younger and healthier cocoa holdings, to other cash crops, or to increased production of food, tobacco or betel nut for sale at local markets to compensate for the declining income from their Stage 3 cocoa holdings. If the household has sufficient land, they are much more likely to establish new cocoa blocks rather than replant their old Stage 3 block. Whilst these old blocks are not generating much income (much less than could be achieved by replanting), growers are reluctant to replant them because they are still generating some income. Also, it is easier to establish a new block on an existing garden site than rehabilitate or replant an old block. This observation is supported by Ghodake *et al.* (1995, p.58) who reported that several farmers in their study had large tracts of land (at least several hectares) planted to cocoa. The level of farm management among these farmers was very low, and the area planted was too large for individual households to manage effectively. Rather than investing their labour in managing their existing mature cocoa blocks and increasing the cash returns, these same farmers were clearing additional land to plant new hybrid cocoa³.

Farming or Foraging

The three stages of block development described above in the model of smallholder production are associated with two very different harvesting and block management practices. In Stages 1 and 2 regular harvesting and some block maintenance, essentially grass slashing, is carried out and we label these two stages, the **‘farming phase’** of the cocoa block (Figure 8.1f). In Stage 3, block maintenance is abandoned and harvesting is intermittent. At this stage the block has entered a **‘foraging phase’** (Figure 8.1f) where the block is visited intermittently in order to ‘forage’ for small quantities of ripe pods. The key differences in cocoa production strategies associated with the farming and foraging phases are summarised in Table 8.1.

During the ‘farming phase’ of Stages 1 and 2, the vegetation structure is such that the open space between the cocoa trees allows easy access for harvesting. Further, because the shade canopy has not yet closed, and the cocoa trees are still receiving adequate light, there is good pod development without significant losses from pests and diseases (e.g., less Black Pod because of the drier micro-climate). Together these factors help sustain growers’ interest in their cocoa holdings so that they are motivated to pursue a farming strategy of production.

Without pruning and shade control, the block passes prematurely into Stage 3, the old, unproductive foraging phase. The premature ‘ageing’ of the block further reduces the motivation of smallholders to commit labour to block maintenance and harvesting, and the cocoa block becomes like any other ‘bush’ resource or old abandoned food garden (see Chapter 6). A downward spiral starts in which pest and disease levels rise even further as labour is withdrawn, creating more disincentives to invest in block maintenance and harvesting. The interrelationships amongst labour supply, block management, tree productivity and harvesting strategies are illustrated in Figure 8.2.

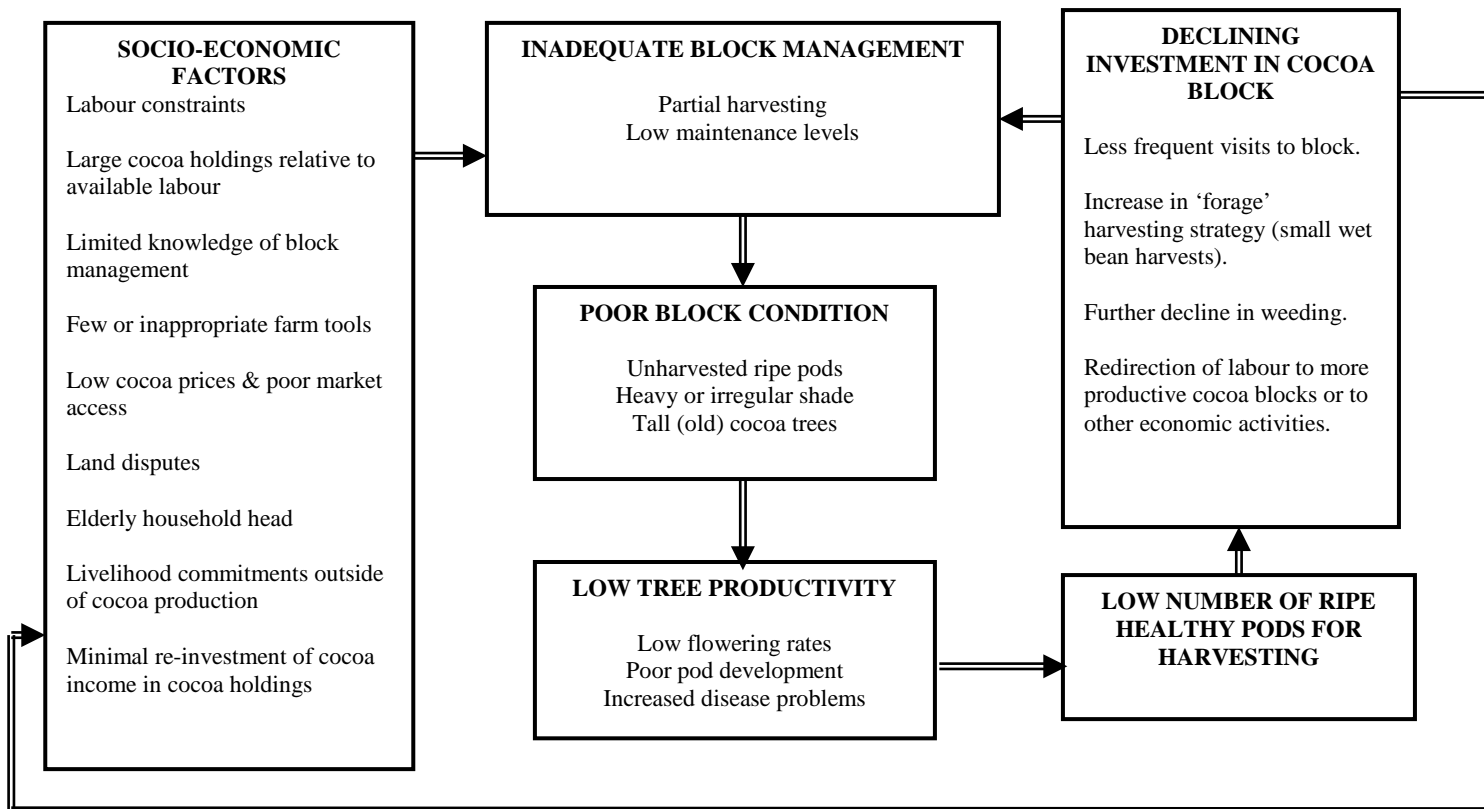
Table 8.1. Cocoa production strategies for farming (Stages 1-2) and foraging (Stage 3)*.

Cocoa Production and Labour Characteristics	Farming Phase (Stages 1-2)	Foraging Phase (Stage 3)
Labour inputs in block maintenance	Relatively high labour inputs in grass slashing at beginning of flush periods.	Very little or no labour inputs in block maintenance.
Harvesting strategy	'Farming harvesting strategy' used through the year. Farmer may revert to 'foraging' during low crop non-flush periods.	'Foraging harvesting strategy' used throughout the year in flush and non-flush periods.
Harvested beans	Processed and sold as dry bean. Some wet bean sales during low crop non-flush periods.	Unprocessed and sold as wet bean.
Harvest duration	Long (>4 hours/day on multiple days).	Short (<4 hours/day).
Harvest frequency and rates	Fortnightly, especially during flush periods. Full harvesting.	Intermittent and partial/under-harvesting.
Size of family work group engaged in harvesting during flush period	Large (3+ labourers).	Small (<3 labourers).
Family labourers	Men, women and children.	Women and children.
Labour recruitment in flush period	Extended family. <i>Varvarmal</i> work groups. Some hired labour on a small proportion of blocks.	Nuclear family.
Purpose of income	Deferred consumption. Large purchases (e.g., school fees, house building materials). Investment in other business such as tradestores or poultry coops.	Immediate consumption. Small purchases (e.g., soap, kerosene, store foods).
Control of income	Controlled by household head, usually the husband/father.	Controlled by harvester, usually individual women.
Importance of alternative income sources	Low (cocoa is the primary income source).	High (labour often diverted to other economic activities).

*Data derived from wet bean and dry bean sales, harvest labour data and family interviews.

Whilst a combination of socio-economic factors influences levels of labour inputs in cocoa production (Figure 8.2), the main factor appearing to influence whether cocoa producers are ‘farmers’ or ‘foragers’ is the quantity of ripe healthy crop easily accessible for harvesting. As argued in Chapter 6, the quantity of accessible healthy ripe pods must be above some minimum threshold level before smallholders will adopt a ‘farming strategy’. If the quantity of ripe pods falls below this threshold, smallholders switch to a ‘forage harvesting strategy’ of very low labour inputs (minimal grass slashing and harvesting), and they will begin to invest their labour elsewhere (Figure 8.2). At this stage, a smallholder might consider replanting the block, but this tends to be deferred indefinitely if there are more productive blocks to harvest or if land is available to plant new cocoa stands. On the Gazelle Peninsula most new cocoa stands are established in new garden sites. In this case, little additional labour is required to establish a cocoa block on a newly cleared garden site compared with the amount of labour required to rehabilitate an old cocoa block.

Figure 8.2. The relationship between labour supply, block management, tree productivity and harvesting strategy.



With the transition to the foraging strategy of Stage 3, the returns to labour are lower, although not as low as they would be if smallholders continued to apply Stage 2 production strategies to their old, Stage 3 cocoa holdings. While the returns to labour on Stage 3 blocks might not be high enough to interest many men, women still consider it worth their while to harvest wet bean for *kwik moni*, but they expend minimal labour in the process. In other words, given the lack of pruning and shade control, Stage 3 foraging strategies are a rational production strategy for old and overgrown cocoa blocks.

The reluctance to replant and the long-term acceptance of very low productivity associated with Stage 3 cocoa blocks means that many smallholder cocoa holdings are in the old unproductive Stage 3 phase for a much longer period than the more productive Stage 1 and 2 phases. Indeed, the evidence presented in this study, together with other studies on the Gazelle Peninsula (e.g., Ghodake *et al.*, 1995; Kakul, 2006) indicate that old and/or overgrown cocoa blocks are the most common type of smallholder cocoa block. Kakul (2006) estimates that 69% of cocoa blocks in Kokopo and Gazelle Districts are aged 11 years and over, 25% of which are more than 21 years old⁴.

Modifications of the Model

The three stage model of smallholder production outlined in this chapter should be considered the standard pattern of smallholder production. The basic model can be modified to accommodate a range of other socio-economic factors that influence smallholder productivity. These socio-economic factors are listed in the left-hand box of Figure 8.2 and can modify the model in two main ways:

1. By expanding or contracting the duration of Stage 2 production by shifting the boundary to the left or to the right between Stages 2 and 3; and,
2. by shifting upwards or downwards sections of the curves for yields, labour inputs and pests and diseases shown in Figures 8.1b and 8.1c.

For example, one or more of the socio-economic factors listed in the left-hand box in Figure 8.2 may lead to a reduction in labour inputs thereby causing pest and disease levels to rise, which in turn may create further disincentives to invest labour in block maintenance and harvesting. This would lead to a contraction of the productive Stage 2 period and a dampening down of the curves for yields and labour inputs and a steeper and upward shift in the pest and disease curve (Figures 8.1b and 8.1c).

One of the most important factors modifying the basic three-stage model of smallholder production is labour shortages, both absolute (e.g., small family size) and functional. For example, in less co-operative households where social conflicts over work and income distribution are common, functional shortages of labour may emerge despite the abundance of ripe, healthy crop available for harvesting during Stages 1 and 2. Family members, particularly the female household head or a married, co-resident son, may be unwilling to provide harvesting labour because they feel underpaid for their labour (see Chapter 6). In these situations, the dry bean production associated with Stage 2 will be below potential levels. Under-harvesting may emerge as a serious problem, which may hasten the build up of pest and disease levels as unharvested pods become reservoirs for diseases such as *Phytophthora*. Thus, the effect of this functional labour shortage on the model is to shift the boundary between Stage 2 and Stage 3 to the left, whereby the block would enter Stage 3 at a younger age. There would also be a dampening down of the curves for yields and labour inputs. In extreme cases where the mobilisation of family labour remains a problem for prolonged periods, the block may not enter the dry bean production phase usually associated with Stage 2, and the household may continue to rely on a wet bean production strategy with relatively small quantities of beans harvested by individual family members working alone.

Towards a Synthesis

Smallholder research spanning over three decades has repeatedly found that smallholders invest inadequate amounts of labour and capital in their cocoa blocks, especially in pruning and shade management. The result, as depicted in the model of smallholder production, is that most smallholder blocks enter the unproductive Stage 3 ‘foraging’ phase prematurely, and this stage dominates the life of the cocoa block. Blocks in poor condition, characteristic of the late phase of Stage 2 and of Stage 3, produce fewer ripe healthy pods for harvesting, creating disincentives for smallholders to invest time and labour in harvesting and block maintenance. Smallholders have a minimum threshold of accessible, healthy ripe pods available for harvesting which influences their production strategies. When yields fall below this minimum threshold, growers adopt a wet bean foraging strategy of very low labour inputs and will shift their attention and labour to other income activities.

The low labour inputs in cocoa production and the premature transition of a cocoa block into the unproductive Stage 3 foraging phase results from a combination of inter-related factors, which may include one or more of the following:

- Insecure or disputed land tenure.
- Shortages of household labour because of the demographic characteristics of households (e.g., elderly households without adult children or young families with dependent children) resulting in low rates of harvesting and poor block maintenance.
- Functional labour shortages where individual family members are reluctant to contribute labour to cocoa production, usually because of disputed remuneration of their labour such as under-payment for work done on family cocoa plots.
- The labour demands of a diverse range of competing livelihood activities.
- The long-term effects of the reluctance of growers to invest labour in block maintenance.
- Overgrown and poorly maintained cocoa blocks suffering from high rates of pests and diseases, leading to few incentives to invest time, labour and finances in cocoa blocks.
- Low density of accessible, ripe pods for harvesting.
- Yield decline of some cocoa varieties after 7 or 8 years of age.
- Limited knowledge of the techniques for block maintenance, especially pruning and shade management.
- Minimal extension advice and training due to shortages of funds and staffing for extension.
- Shortages of tools for effective block maintenance.

These findings concur with the results of earlier studies (see Chapter 2) which also identified poor farm management practices as a primary constraint on smallholder production. As outlined in Chapter 2, previous studies in ENB (e.g., Nicholls 1989; Yarbrow and Noble, 1989; Ghodake *et al.*, 1995; Lummani & Nailina, 2001; Omuru *et al.*, 2001) identified the main constraints on smallholder production as:

- Labour shortages.
- Poor agronomic and farm management practices (high pest and disease levels).
- Land tenure insecurity.
- Low cocoa prices.

For various reasons smallholders are reluctant to invest labour in block maintenance even though the returns on such investments of labour would be significant. Cocoa production is but one of many social and economic activities

undertaken by smallholder households. Smallholder livelihoods are increasingly reliant on a range of income sources as people respond to the various economic pressures (e.g., rising school fees and store prices) and new opportunities (e.g. new markets in vanilla production or non-farm employment) in their lives. By deploying their labour in particular ways (e.g. in wet bean sales or dry bean processing) across a range of livelihood activities, overall livelihood security and income may be enhanced (e.g., diverse income sources versus reliance on a single income source). However, such diverse livelihood strategies may require some sacrifice in cocoa productivity. Therefore, tolerance of high levels of cocoa pests and diseases, and low labour inputs may be considered appropriate strategies within an overall set of livelihood strategies.

To some extent cocoa competes with other income activities for family labour, time and investment capital. If the cocoa block is not providing sufficient income to meet the many cash needs of the family it is likely that family members will divert their labour to other, more profitable activities where the returns to labour are higher. This is especially the case when a block enters Stage 3 where returns to labour from selling wet bean are low relative to dry bean production.

Low harvesting rates and minimal labour inputs in cocoa block management by smallholders are therefore not new and many years of extension and training have not generated significant improvements in block management or smallholder productivity. Raising smallholder productivity is very difficult, and what this and earlier studies have pointed to is the complexity of the issues involved: there are no simple solutions.

Developing strategies to overcome the complex and long-standing constraints on smallholder productivity, particularly the premature transition of cocoa blocks into the unproductive Stage 3 foraging stage, requires innovative approaches that accommodate current smallholder farm management practices, existing extension efforts, the everyday needs and circumstances of cocoa smallholders, and which also create new incentives for smallholders to devote more time and labour to cocoa production. In the final chapter we turn to consider extension approaches that move beyond educating smallholders about block management to approaches involving partnerships between the commercial sector and smallholder farmers.

Chapter 9

Strategies for Improving Smallholder Production and Incomes

Drawing on the smallholder model of production discussed in Chapter 8, this chapter proposes several strategies to raise smallholder productivity and to place the smallholder sector in a more viable position for the future. There is considerable potential on the Gazelle Peninsula, and within Papua New Guinea generally, to increase smallholder production and strengthen smallholders' role in export production without expanding the area of cocoa under cultivation. The strategies outlined below give priority to increasing productivity from existing cocoa holdings by addressing the main constraints on production. These strategies singly or in combination are to achieve the following objectives:

1. Reverse the downward spiral of falling production, income and labour investments which characterise old Stage 3 blocks.
2. Shift from an extension model of 'teaching' farmers about block management, to a system where the extension agents work in 'partnership' with smallholders.
3. Enhance smallholder motivation to produce cocoa by focusing on strategies to improve the quantity of easily accessible crop available for harvesting.

Increase Smallholder Production by Promoting the Income Benefits of Extending the Period of Stage 2 Production.

The quantity of accessible crop available for harvesting influences the type of production strategy employed by households. High producing blocks in Stage 2 (the farming phase), where pest and disease losses are relatively low, are harvested more frequently and have higher investments of labour in block maintenance (almost exclusively grass slashing) than blocks that have progressed to Stage 3. The poorly maintained Stage 3 block becomes a 'bush' resource (the foraging phase), irregularly harvested when there is an immediate cash need.

The aim in improving smallholder productivity is twofold. First, there is a need to extend the Stage 2 farming phase through improved block management to prevent blocks entering prematurely into Stage 3, so that there is a longer period when the block is producing sufficient crop for dry bean production. An extended Stage 2 will motivate smallholders to invest labour in harvesting and

dry bean processing. Second, it is necessary to promote replanting (where rehabilitation is not a viable option) to eliminate the unproductive Stage 3 (see below) (Figure 9.1). Timely replanting would initiate a reversal of the downward spiral of declining labour inputs associated with rising pest and disease levels and falling yields, to an upward cycle of rising yields. This would act as an inducement for smallholders to commit more labour to block maintenance and harvesting for dry bean production.

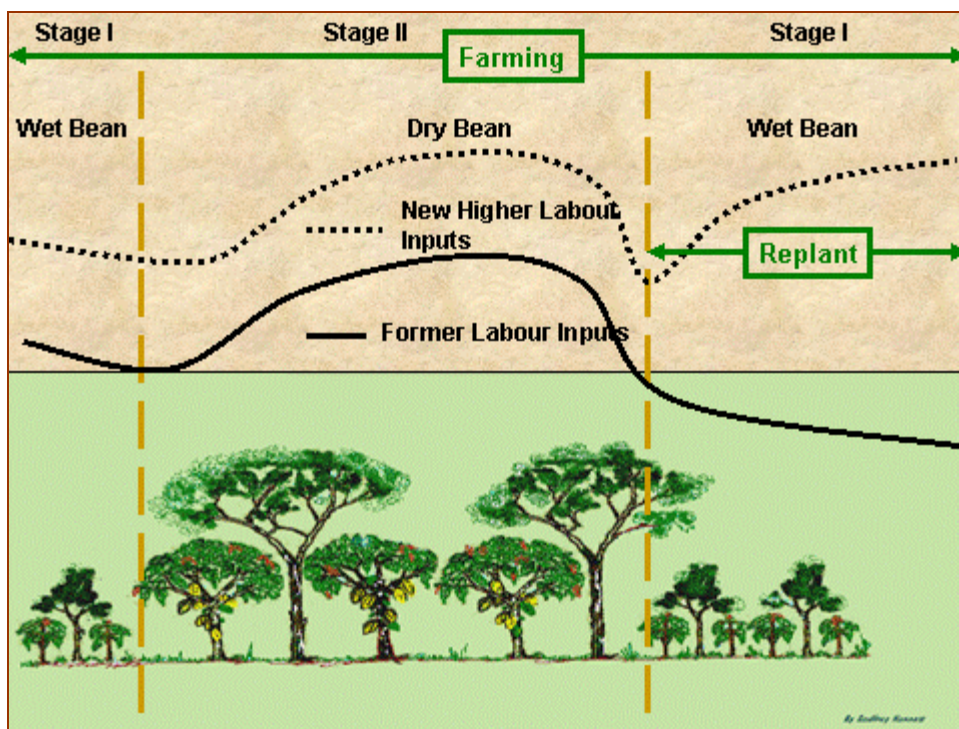


Figure 9.1. The new two stage model of smallholder cocoa production (Stage 3 eliminated).

To extend the productive Stage 2 phase, further promotion of the importance of regular pruning and shade control is required, as is training in the techniques of correct pruning and shade control¹. However, it is likely that even if extension services were readily available for training in pruning and shade control techniques, which they are not, the impact on productivity would not be great. Traditional extension activities that rely solely on ‘teaching’ smallholders block management techniques do not increase productivity significantly, as recognised by extension officers (see Chapter 7). More innovative extension strategies must be developed.

One extension strategy to improve productivity would be to raise awareness amongst smallholders of the income losses associated with the Three Stage model of production by making more visible to smallholders the relationships between different block management practices and future income flows. For example, explaining the benefits of pruning on a late Stage 2 or Stage 3 block in terms of reduced pests and diseases, anticipated yield increases and future income flows may encourage growers to act on extension advice. It should be emphasised how pruning a block of a particular age can generate additional income over the following 18 months, and extend the productive life of the cocoa block by a given number of years. It would also be necessary for the extension message to explain how short-term income losses associated with heavy pruning are compensated by larger incomes over the longer term².

The distinction between short-term and long-term gains could be highlighted further among smallholders by using the Three Stage model of block development. By quantifying the short and long-term income gains from pruning, smallholders would be more knowledgeable about the future returns on their labour, thereby increasing the effectiveness of extension messages.

While linking labour inputs to future income flows in extension messages may go some way to encouraging smallholders to make larger investments of labour in block maintenance, it misses some of the fundamental constraints on labour supply that contribute to high rates of under-harvesting (see Chapters 5 and 6). The labour constraints operating within smallholder families must be taken into account in the development of extension strategies, and ways of overcoming such constraints must be identified and promoted. For example, extension training could be accompanied by the promotion of the use of village work groups (e.g., youth, women, church and sports groups) to undertake pruning and shade control where labour shortages are a major constraint on production. A more ambitious strategy to overcome labour constraints, which is being attempted in several locations with some success in the provinces of ENB and WNB, is the Nucleus Enterprise model of extension described below.

Promote Rotational Replanting.

Most growers do not think about replanting until the block is well into Stage 3 and cocoa income is so low that they cannot afford to replant from recurrent income. Thus, strategies that lessen the financial burden of replanting must be devised to overcome such reluctance. The current extension recommendation of whole-block replanting should be replaced with a rotational/staged replanting

strategy to make replanting affordable. For example, replanting approximately 60–100 trees at a time on a 1 ha block, or 10% of the block each year (G. McNally, NGIP-Newmark, pers. comm., January 2006), has several advantages over the conventional whole-block replanting method³. First, under a rotational replanting program a significant proportion of the block remains in the productive Stage 2 phase (70% of the cocoa stand), which would be more than sufficient to finance replanting while providing the family with a relatively high level of income. Under a 10% rotational strategy, 30% of the block would be in Stage 1 (10% less than 1 year old, 10% 1 year old, and 10% two years old) and 70% would be in the productive Stage 2 phase. G. McNally (NGIP-Newmark, pers. comm., January 2006) identifies the following advantages of staged or rotational replanting:

- Affordability. Replanting can be funded from recurrent income.
- Consistent yields with a gradual improvement through time.
- Opportunities for farmers to introduce new cultivars on a regular basis.
- Opportunity to improve aspects of block management such as planting density and formation pruning.

Design Replanting Packages that Suit the Management Practices and Needs of Smallholder Families.

A suite of replanting packages should be designed to meet the needs of the main types of smallholder families. The particular replanting package promoted to a farmer wishing to replant should be based on an understanding of the characteristics of his/her household, characteristics that could be easily ascertained with the use of a simple checklist at the seedling distribution point. Factors that should be taken into account when determining which replanting package to offer a grower include: availability of family labour (e.g. demographic characteristics of household); the personal priorities and objectives of the grower (e.g. need for income for paying school fees, investing in other businesses, etc); the economic situation of the household (access to land and other resources); their approach to cocoa farming (high levels of investment in farm inputs versus low levels of investment in farm inputs); and, the relative importance of cocoa production in household livelihood strategies. For instance, it would make little sense to supply a grower experiencing long-term labour shortages with only hybrid clones that require high inputs of labour. It would be more appropriate to recommend to these growers that they purchase cocoa varieties tolerant of low labour inputs, and/or limit their seedling purchases to a quantity that can be effectively maintained given their household labour supply.

Ideally, replanting packages should include:

- Promotion and advice on intercropping of replanted cocoa with food crops to encourage weed control.
- Selection of the most appropriate cocoa variety given the circumstances of individual farmers and their families (e.g. available labour supply and financial needs). This may involve the development of a suitability ranking for smallholders of the different varieties of cocoa hybrids and clones.
- Advice on the most appropriate type of cocoa shade given household labour supply and commitment to cocoa production.
- Training and information on appropriate farm management techniques. Replanting with new cocoa hybrids and cocoa clones should be accompanied by training in the farm management techniques appropriate to the newly released cocoa varieties.

Each point is addressed below.

Intercropping of Cocoa

The best managed cocoa stands are young cocoa blocks interplanted with food crops (Ghodake *et al.*, 1995; see Chapter 7). Thus, intercropping newly replanted cocoa blocks with food crops and fruit trees would encourage growers to visit and weed their blocks more frequently. Similarly, mature cocoa blocks shaded by fruit trees and bananas may encourage more regular visits to the block and increase incentives to undertake block maintenance (the block provides cash income and food). In the 1970s, Bourke (1976) described how smallholders in some areas of the Gazelle modified their food crop systems by interplanting cocoa with bananas, Chinese taro and coconut. As Bourke noted, such a system “evolved without the assistance of the Department of Agriculture and at times in direct opposition to its policy of separating food and cash cropping into different areas” (1976, p.93).

The advantages of intercropping cocoa have been documented in other cocoa growing countries (e.g. Johns, 1999; Rice & Greenberg, 2000; Rosenberg & Marcotte, 2005). Advantages include more thorough weeding and reduced levels of pests and diseases. Pathology scientists at CCI are currently examining intercropping as a smallholder strategy for improved pest and disease control and CCI’s plant breeders are evaluating the advantages of planting cocoa clones in a ‘strip cultivation’ system (alternating strips of cocoa and food crops) (Efron, 2004; Konam & Namaliu, 2005). These cocoa farming systems have the potential to deliver significant improvements in block condition.

Cocoa Variety

Cocoa is a labour intensive crop and several recent releases of SG2 hybrids and hybrid clones require greater labour inputs (and different farm management practices) than earlier cocoa varieties such as Trinitario. There is also evidence of early yield decline in SG2 hybrids and in some of the recently released hybrid clones (Figure 6.3). Whilst recent releases of cocoa materials offer higher potential yields and improved disease resistance than earlier varieties, their high maintenance requirements, specialised pruning regimes and susceptibility to early yield decline, mean that potential yields may not be realised by smallholders experiencing labour shortages or without access to extension training and advice.

Thus promotion of clones to smallholders must be balanced with the recognition that most hybrid clones require relatively high levels of labour inputs and complex management practices, without which they are prone to high mortality rates and damage from pests and diseases. It is unrealistic to assume that hybrid clones will receive the necessary levels of management inputs when decades of research have consistently shown that most smallholders do not undertake basic block maintenance tasks (Chapters 3 and 7). Moreover, in remote areas where market access is poor or highly variable, there may be a case for encouraging smallholders to plant more robust planting material such as Trinitario which can tolerate prolonged periods of neglect and then be brought back into production when prices are high or when market access improves. These issues require further investigation by CCI.

CCI's breeding section has already begun to develop informal guidelines regarding the suitability for smallholders of some types of hybrids and hybrid clones. These informal guidelines are based on the potential vigour and required management practices of the different cocoa varieties. However, further research is required using multi-location on-farm trials of new planting materials under a range of smallholder conditions and environments to develop guidelines that can be used when recommending planting/replanting packages to smallholders. Such guidelines could incorporate a suitability ranking of the various hybrids and hybrid clones based on the key factors affecting smallholder production (e.g. labour availability and management practices) and the characteristics of the tree itself (e.g. sensitivity to labour inputs, management practices and tree size). For example, there is evidence to suggest that some of the smaller hybrid clones may be more suitable for smallholders than larger hybrid clones because they are of shorter stature and therefore easier

to maintain and harvest (D. Yinil, CCI, pers. comm., 2004). Also, small clones may require less pruning labour than SG2 hybrids (G. McNally, NGIP-Newmark, pers. comm., 2007⁴). The reluctance of growers to harvest pods on the upper branches of tall trees (which become a reservoir for *Phytophthora* – Chapter 7) may also be an advantage of the small hybrid clones over some larger cocoa varieties.

Cocoa Shade

Many smallholders in ENB have planted cocoa under coconuts, but increasingly *Gliricidia* has been promoted as a shade tree and is commonly used in areas around Vunalaing where beetle damage to coconuts curtails the use of coconut shade. The adoption of *Gliricidia* has led to widespread problems of overshading of cocoa trees and the creation of a moist micro-environment in cocoa stands which is more conducive to pests and diseases. The selection and management of shade trees is crucial for managing diseases such as *Phytophthora* (McMahon & Purwantara, 2004). Thus the promotion amongst smallholders of *Gliricidia* for cocoa shade should be reassessed. This recommendation echoes that of Ghodake *et al.* (1995, p.125) made more than ten years ago: “urgent attention [be paid] to the evaluation and promotion of alternative shade tree species that require low management”. Ghodake *et al.* (1995) suggest alternatives such as kalava, betel nut, marum and a range of fruit and nut trees which accords closely with the intercropping system advocated above.

In areas where the Rhinoceros Beetle is not a significant coconut pest, coconuts should be promoted as a shade crop for cocoa, particularly for farmers practicing low labour input production. Coconuts have long been recognised as the best shade crop for cocoa (consistent shade level, little maintenance required and a source of additional income — see Benton & Belfield, 1995), and the Kokonas Industri Koporesen’s⁵ recent promotion amongst smallholders of the production of high value coconut products such as virgin coconut oil, has the potential to substantially increase and diversify the incomes of mixed cocoa-coconut producing households. Omuru (2005) estimates that a farmer selling copra and virgin coconut oil with cocoa can anticipate a 134.6% increase in gross income. Moreover, it is known that cocoa under coconut palms in PNG has fewer pests and fungal pathogens (Smith, 1981).

CCI to Investigate New Extension Models that Involve Partnerships Between the Commercial Sector and Smallholder Communities.

As highlighted at the beginning of this chapter, decades of conventional agricultural extension to ‘teach’ block management techniques have not resulted in significant productivity gains for smallholders. As the Three Stage Model of smallholder production has revealed, in the absence of pruning and shade control, cocoa blocks at about 7 or 8 years of age inevitably slide into a downward spiral of increasing neglect, rising pest and disease levels and falling yields and income (the bush foraging strategy associated with Stage 3 production — Figure 8.2). Conventional extension strategies appear unable to reverse or even arrest this decline. Therefore, it is recommended that CCI investigate the potential of promising new extension models involving the commercial sector working in partnership with smallholders to raise productivity and incomes. Such partnership models would be less dependent on the erratic and uncertain government funding that has plagued extension efforts in recent years.

One promising approach, which is gaining traction in PNG, is the Nucleus Enterprise (NE) model involving ‘partnerships’ between the commercial sector and smallholder producers. Partnerships can range from the provision of farm management advice and seedling distribution by a village entrepreneur possessing the necessary business and agricultural skills, to joint venture companies between customary landowner groups and commercial companies. An aim of such partnerships is for extension and related services to become an integral part of the everyday production activities of smallholders as their ‘Commercial Service Provider’ (CSP) becomes an active participant in the production process. There are opportunities for existing government extension services (e.g., those provided by CCI and DPI) to be integrated into the NE model, particularly through supporting village entrepreneurs in their role as CSPs to their client communities (see below).

A Template for a Nucleus Enterprise Model⁶

Each NE, comprising 50-200 smallholder growers and their families, would be serviced by a CSP located centrally in each NE. The most basic version of the model entails the CSP providing extension advice, processing facilities and a nursery for the supply of cocoa seedlings to growers. Smallholders without their own processing facilities would supply wet bean to their CSP and receive a portion of the dry bean price. The CSP would buy and process wet bean and purchase dry bean processed by growers, and transport and sell dry bean to exporters in town. Returns to growers are anticipated to be above current wet

bean prices (mainly because of reduced production costs — see below), and the operation and maintenance of the NE would be self-financing.

This basic model of the NE can be scaled-up to provide growers with a range of additional productivity enhancing services, which may lead to other development opportunities for the farming community. For example, additional CSP services might include training in fermenting and drying wet bean, credit for tools and processing facilities, and the implementation of quality control measures in the production process. Importantly, the coordination of production provided through a NE arrangement offers scale economies that would reduce production costs for growers, especially in the areas of transport and processing. A fortnightly pickup of crop (of both wet and dry bean) by the CSP, for example, offers considerable savings on transport compared with the typical situation where individual growers hire private vehicles to transport crop to town buyers⁷. NGIP-Newmark has been operating a similar NE model with smallholders in the Bainings area of ENB with very successful results in raising smallholder incomes and productivity.

Also, the structuring of work patterns resulting from fortnightly pickups of crop will encourage regular harvesting and block maintenance as a result of predictable market access at significantly reduced costs. When growers know and are confident that their crop will be picked up on a certain day, they will count back the number of days to when harvesting should commence in order to leave sufficient time for processing wet bean. Thus, the combination of guaranteed market access, credit facilities and the ready availability of extension advice and good planting material on-site will raise smallholder productivity and incomes and the quality of the final product through an extension of the farming phase associated with Stage 2 production.

The NE concept has broad similarities to the nucleus estate-smallholder model adopted by the successful oil palm industry in PNG. A key difference, however, is that oil palm companies operate their own plantations in addition to servicing the smallholder sector. Under the NE model it is not necessary for the CSP to own or lease plantations, though this is not precluded by the model. CSP services may be limited to processing, marketing and extension provision, and purchasing wet bean (for CSP processing) and dry bean processed by smallholders. The profitability of CSPs is partly dependent on smallholder productivity, which in turn is influenced by smallholder management practices, the quality of extension services and the availability of credit for tools, planting

material and other inputs. There is, therefore, a financial incentive for the CSPs to supply quality services in a timely manner to their smallholder clients.

Organisation of NEs

NEs could be established in a range of smallholder situations: in village communities; on plantations that have been returned to customary landowners; and in land settlement schemes based on cocoa production. Many plantations returned to customary landowners are characterised by extremely low productivity and are carrying large debts, typically accumulated when the plantations were managed by management agencies. If these plantations were surveyed, 'blocked' and allocated to individual families from the customary landowner group within a NE framework, then there would be considerable potential for productivity increases and the repayment of loans through a centralised payment system (see below). With each family carrying a share of the total debt, it then becomes possible to clear debts and transfer leasehold title to individual families⁸.

In village settings and land settlement schemes, cocoa farmers producing and selling wet bean would be organised into NEs by grouping council wards, local level government (LLG) areas, or land settlement subdivisions to a yet to be determined threshold for economic viability of an NE (50 to 200 families). CCI could assist in this process and also liaise with ward councillors or LLG presidents for the allocation of a portion of land for the CSP to establish processing facilities and a nursery (perhaps under a lease arrangement to give the CSP some tenure security).

The NE approach has advantages over existing extension models. Two broad sets of advantages which are discussed further below include:

- An integrated approach to CCI's extension.
- A centralised payment system that offers opportunities for mobilising labour (through innovative payment mechanisms), providing credit facilities (and a mechanism for debt recovery), and a means to finance community development initiatives.

An Integrated Approach to Extension and Research

With its considerable resources in extension, plant breeding, entomology and pathology, CCI is well-placed to support the extension role of CSPs, especially those CSPs lacking the resources of the larger companies. It is also well-placed to conduct on-farm research trials. Examples of some of these potential activities are listed below.

The establishment of *CSP nurseries will improve smallholder access to the latest CCI technologies*. With appropriate training from CCI, CSP nurseries will be able to raise and sell healthy hybrid cocoa (and coconut) seedlings and cocoa clones to their NE smallholders. The proximity of nurseries to growers' blocks means farmers will save on transport costs.

CCI extension services tailored to the needs of individual NEs. Village entrepreneurs who become CSPs can be trained and supported by CCI. Bringing CSPs together for training in formation pruning of the hybrid clones, for example, will improve the cost-effectiveness of CCI extension activities. CSPs with similar training needs can be brought together as a group in one CSP centre and given short courses to address those needs. Field demonstration plots managed by each CSP with advice from CCI would enable smallholders to see how different management strategies for cocoa blocks affect yields and pest and disease rates.

On-farm trials of new cocoa varieties would be relatively simple to organise and coordinate with the cooperation of CSPs located amongst grower communities. Smallholders would also benefit by being directly involved in the Institute's research programs (adaptive research), and their participation in on-farm research should encourage rapid uptake of new technologies as they are released by CCI. Smallholders participating in on-farm trials could be viewed as 'early adopters' who would serve as demonstration farmers to those who are typically more cautious in their uptake of new technologies. Further, and very importantly, CCI researchers working on these trials would become more sensitive to and knowledgeable of the smallholder sector — something that is much more difficult to achieve when trials are limited to research stations as has largely been the case in the past. On-farm trials will create a two-way flow of information between CCI and smallholders thereby enabling the needs of smallholders to be communicated more effectively to CCI senior management.

The central processing facilities provided and operated by the CSP will improve the quality of processed cocoa which has been declining for reasons such as smoke tainting because of faulty kiln pipes and simple negligence. The NE with a CCI-trained CSP using the latest processing technologies will lead to improvements in quality. Quality assurance procedures implemented by the CSP in regard to dry bean processing by smallholders will also improve the quality of dry bean.

Also, processing by the CSP will lead to higher conversion ratios of wet bean to dry bean. Village producers achieve conversion rates of around 30–35%, but with appropriate processing facilities and procedures, CSPs would achieve conversion ratios in the order of 40–45%, thereby improving the value added component of production.

Centralised Payment System to Mobilise Labour, Provide Credit Facilities and Finance Community Development Initiatives.

The centralised payment system of a NE offers opportunities to introduce a range of other productivity enhancing initiatives and create development opportunities for smallholder communities. In this section we outline three broad areas in which a central payment mechanism could be used to enhance productivity and development opportunities for the NE community of growers: 1) strategies for the mobilisation of labour; 2) the provision of credit facilities (micro-credit); and 3) savings mechanisms for community development initiatives.

1. Mobilising Labour

Research on oil palm and coffee smallholders in PNG (e.g., Overfield 1998; Koczberski *et al.*, 2001; Curry & Koczberski, 2004; Koczberski, 2007) and smallholders in other countries (von Bulow & Sorensen, 1993; Dolan, 2001), reveals that uncertain, irregular or underpayment of family and hired labour creates disincentives to family members to contribute labour to cash crop production. For example, in PNG, prior to the introduction of a separate payment system for female oil palm smallholders for the collection of ‘loose fruit’ (the ripe fruitlets dislodged from the oil palm bunch during harvesting), most women were reluctant to collect loose fruit because of the uncertain remuneration of their labour by their husbands. They preferred to invest their labour in areas where they were confident of a return on their labour (e.g., food production for sale at local markets). However, the advent of the ‘*Mama Lus Frut*’ scheme led to a large increase in the supply of female labour in oil palm production because they were guaranteed timely payment for their labour by the milling companies. Similarly, the present study has found that one of the major constraints on the supply of labour in cocoa production is payment uncertainty, particularly of family members.

The centralised payment system of the NE provides a mechanism for mobilising labour for block maintenance tasks such as pruning, shade management and the control of pests and diseases such as Black Pod and Cocoa Pod Borer. Most rural communities in PNG have youth, women, sporting and

church groups which are often available for hire for labour-intensive tasks such as the cutting and clearing of bush for new food gardens and cutting timber and thatching materials for housing. If such groups, trained by their CSP, were contracted to undertake labour-intensive tasks such as pruning and shade control they could be paid by their CSP by a small deduction from growers' cocoa payments. Thus the reluctance of growers to pay cash for labour would be overcome and the yield response resulting from improved block maintenance would more than compensate for the deductions from growers' incomes for the payment of hired labour.

Lighter tasks such as pest and disease control measures, like the removal of *Phytophthora* affected cocoa pods, which are a source of disease inoculant while remaining on the tree, could be contracted to women's groups or church groups. The removal of diseased pods would significantly reduce infection rates amongst maturing pods thereby increasing the amount of healthy crop available for harvesting.

The payment of labour for block maintenance tasks funded by small deductions from growers' payments would be much more attractive to growers than paying cash for labour. In an ideal situation, local youth groups skilled in pruning and shade control, and with access to appropriate tools, would perform these essential block maintenance tasks. Such a maintenance programme would extend Stage 2 production (the farming phase). This combined with the rotational replanting programme discussed above would mean that most blocks would remain in the high production Stage 2 farming phase indefinitely. The combination of higher yields and improved accessibility would be a stimulus for dry bean processing and the deployment of larger harvesting groups.

The centralised payment system can be used in other ways to maintain production. For example, when a grower is ill or moves away for an extended period (e.g. working in town) they can arrange with the CSP to pay a labourer to work on the block to ensure production and maintenance are not neglected. Payment to the labourer would be made by deductions from the grower's payments, while the cocoa grower would still receive an income during the time when they are unable to work on the block. In effect, the CSP guarantees payment of the labourer for work done thereby ensuring the latter's ongoing commitment to production.

The mobilisation of labour for block maintenance tasks should be timed so as not to coincide with the biannual cocoa flushes in order to maximise the supply of harvesting labour during peak cropping periods. Labour-intensive block maintenance tasks such as pruning and shade control should be timed, as far as possible, to coincide with periods of high cash demands. For example, the motivation of youth groups to perform contract pruning and shade control would be greater when school fees are due. These sorts of considerations should be taken into account by CSPs designing block maintenance programmes.

2. Provision of Credit Facilities

The centralised payment system would enable larger CSPs, like private companies, to provide credit facilities to individual growers for small purchases such as seedlings, tools and other farm inputs. These loans could be recouped from growers through deductions from their cocoa payments. For assets requiring larger loans such as for fermentaries and dryers, group loans to members of an extended family group who intend sharing the processing facilities, might be preferable to individual loans. Loan repayments are dependent on a level of trust and genuine partnership developing between the CSP and its NE clients. In areas where there are multiple buyers of crop (e.g. near urban centres), these sorts of credit facilities would be more difficult to establish than in isolated regions where there may be only a single buyer operating.

3. Savings Mechanism for Community Development Initiatives.

The centralised payment system through the CSP could also provide a savings mechanism with the potential to generate considerable social benefits for members of the NE. Benefits can be at three levels: the individual, the group (e.g. family, sports or church) and the community. For the individual grower, an agreed savings rate based on production (e.g. 10 t/kg of wet bean) could be deducted from CSP payments to growers and locked away in special purpose savings accounts thereby enabling smallholder cocoa income to be transformed into material improvements in the quality of life for growers. Such a savings mechanism would provide a powerful incentive for growers to raise productivity. Rather than most income being expended on immediate consumption or dissipated through social and kinship networks because of the demands of the traditional exchange economy as at present, a proportion of smallholder income would be isolated from such demands and therefore be available for investment in improved living conditions (e.g. water supply and

housing). A savings mechanism would create a strong and direct relationship between cocoa productivity and material improvements in living standards thus increasing growers' motivation to invest labour in their blocks.

The same savings mechanism could also be used to fund the activities of community groups where savings contributions up to a set amount are deducted from each group member's payments and paid into a group account. Soccer teams and women's groups, for example, could use the mechanism to raise funds whether as voluntary donations to the fund through deductions or by hiring out the group's labour for block maintenance tasks.

Other possibilities include implementing, with the broad consent of the NE community, a 'community development' levy on production. Such a levy could fund projects and services such as upgrading of aid posts, water supply, feeder roads, etc., with project and service priorities determined by the community. Moreover, if a 'kina for kina' arrangement were negotiated with the LLG to fund projects and services that the community requires, this would further increase the social benefits of the community development fund. More importantly, such initiatives involving partnerships between LLGs and NE communities would create amongst the communities a sense of ownership and responsibility for projects.

In summary, the NE provides a platform for an extension of the Stage 2 farming strategy and the replacement of the unproductive Stage 3 foraging strategy with Stage 1 replant (Figure 9.1). The benefits for growers, their families and their communities include:

- Enhanced market access.
- Lower costs of production, particularly for transport and processing.
- Improved quality of product.
- Higher productivity.
- Improved and more carefully targeted extension services and training.
- Access to quality planting material.
- Improved access to credit.
- Increase in household incomes.
- More employment and business opportunities for smallholders.
- Mechanism for financing community development activities.
- Greater participation of women and youth in export cash crop production.

Thus, the NE model has considerable potential to raise smallholder productivity by altering the way extension services are delivered to growers. Further, as has already been demonstrated by the oil palm industry, the centralised payment system made possible through the coordinated production of a NE also provides a mechanism for transforming cocoa income into improvements in the standards of living of growers and their communities, thereby creating additional incentives for growers to raise productivity and incomes. Perhaps more importantly, from the perspective of growers and their communities, the centralised payment mechanism offers a way to generate rural employment opportunities for youth and women by mobilising labour for block maintenance. It also opens up a range of other development opportunities for the community through the provision of savings mechanisms and development levies.

The broad nature of the strategies described in this chapter to improve smallholder production and incomes point to the complex and wide ranging constraints on smallholder productivity. Key aspects to improving smallholder production are to reverse the premature transition of cocoa blocks into the unproductive Stage 3 foraging phase and to enhance smallholder motivation to invest labour in cocoa production through improving market access and the productivity of their cocoa holdings. The strategies discussed above to address these issues go beyond simply increasing the production and incomes of smallholder households but also aim to reinvigorate the cocoa industry through encouraging the commercial sector to take more responsibility for the delivery of extension and other services to smallholders. This will also generate wider social benefits for the community and rural employment opportunities for youth and women. This broader approach is needed if the cocoa smallholder sector is to be put on a sustainable footing for the future.

Chapter Notes

Chapter One

1. The oil palm industry expanded rapidly in the last decade and became the main export crop in 2001, followed in second place by coffee.
2. However, changes in exchange rate policy prompted by the IMF stabilisation programme in 1994 led to the devaluation of the local currency. Thus domestic commodity prices exceeded the minimum guaranteed price and hence bounty (deficiency) payments ceased in 1994.

Chapter Two

1. In late 2003 CCEA was amalgamated with CCRI to form CCI.
2. Some land at Bulupa was previously owned by the Uniting Church mission.

Chapter Three

1. For a detailed discussion on changes to land use and land tenure on the Gazelle Peninsula, see Salisbury (1970) and Lowe (2006).

Chapter Four

1. Only those members of the family residing with a household at the time of the survey were recorded as belonging to the household. Absentees of more than seven nights away or married children living independently were excluded. Median household size of 8 on the Gazelle Peninsula was reported by Ghodake *et al.* (1995). Omuru *et al.* (2001) recorded median household size of 7 in their ENB study. According to 2000 census data, average household size for ENB is 5.6.
2. The relatively high proportion of children attending school is an indication of the importance families place on education. This is despite increases in school fees over the last five years which have undoubtedly placed a substantial financial burden on most families. For this population, schooling is a central part of young children's lives, and school activities such as end-of-year graduations are very important community events.

3. Sometimes individuals came together in a group to contribute funds to repurchase plantations with the intention of either managing the plantation as a group concern or subdividing it into smallholder blocks. If the latter option was followed, the size of an individual's block was determined by the proportion of the total payment made by that particular individual (M. Tabar, CCI, pers. comm., 2005).
4. There have been cases where customary landowners claimed that their land was forcefully alienated by authorities or purchased by dubious means by traders. Some of these customary landowners have reposessed their land outside the legal process of purchasing the land under the government's land reacquisition and distribution scheme (W. Reven, Lands Office, Kokopo, pers. comm., 2005).
5. If payment is made in cash, the clan leader may trade the cash for shell money for the long-term benefit of the clan. A common practice to obtain shell money is to purchase pigs (or piglets to be raised) which are later slaughtered and distributed to clan members for shell valuables.
6. Similar disputes over inheritance of leasehold blocks occur on the Hoskins and Bialla oil palm land settlement schemes in WNB Province (Koczberski *et al.*, 2001).

Chapter Five

1. Estimates of annual household income for dry bean sellers were obtained by averaging mean income earned per dry bean harvest sale for income data for smallholders in the Kokopo-Vunamami LLG and Livuan-Reimbar LLG areas from October to December 2003, from May to October, 2004, and from December 2004 to January 2005. The mean income earned per dry bean harvest sale (taken from socio-economic survey and weekly survey results) was then multiplied by five. The latter figure is the estimated average number of dry bean sales per year made by ENB smallholders reported by Omuru *et al.* 2001. It should also be noted that dry bean sellers occasionally sell some wet bean when they need cash for immediate consumption. These wet bean sales have not been included in the dry bean annual income total. Annual income from wet bean sales was calculated by multiplying the average mean income earned per wet bean harvest sale of K17 by 24 weeks, which is the estimated number of times wet bean is sold per year by households in the sample. Cocoa prices during the survey

period ranged from K0.80 to K1.20/kg for wet bean, and K250 to K285 for a 63.5 kg bag of dry bean.

2. The large percentage of time spent 'resting at house' was influenced by frequent rain events during the survey period. It also incorporates leisure time and socialising. Similarly, illness frequency was higher during wet periods.
3. The constraints on female labour in smallholder oil palm production in PNG were overcome with the introduction of the *Lus Frut Mama* Scheme, which pays women separately from their husbands for their work carried out on family oil palm plots (see Koczberski, 2007).
4. The term 'market related activities' combines the columns 'garden production for markets' and 'market activities' in Figure 5.6.

Chapter Six

1. While the very large disparity in incomes between wet and dry bean sellers reflects the economic advantages of owning a fermentary, it is likely that the income disparity is not quite as large as first appears. Many dry bean sellers purchase wet bean so their net incomes are reduced and many growers who sell wet bean to exporters in town would also sell to village processors so their income is under-estimated.
2. To be eligible for a cocoa fermentary license from the Cocoa Board, an individual must have at least 2 ha of cocoa. It is also a condition of the license that production does not fall below 2 tonnes per year (32 bags of export quality cocoa per annum).
3. It is now very difficult to establish coconuts in East New Britain Province because of these pests.
4. When questioned about the theft of cocoa pods, extension officers commented that young men's theft of cocoa pods was partly driven by their dissatisfaction with the level of remuneration of their labour by their fathers.

5. G.McNally (NGIP-Newmark, pers. comms., May, 2007) claims that changes in yield make a large impact on smallholder investment decisions, far more so than changes in price.
6. Curry and Koczberski carried out extensive garden surveys in 1988-89 in the village of Miko 2 in the Wosera sub-district.

Chapter Seven

1. Data are drawn from the repeat weekly surveys of households, the baseline socio-economic survey and the cocoa farm management assessments (see Chapter 2 for details).
2. Growers report that there can be very high mortality rates amongst the new hybrid clones when they are young if weeds and grasses are not kept under control. They attribute the higher mortality rate of clones to their greater sensitivity to over-shading and greater vulnerability to ringbarking by Longicorn larvae. Growers claim that the bark of hybrid clones is thinner and softer than the bark of older cocoa varieties.
3. VSD is noticeable because the leaves on infected branches dry out and turn brown.
4. Whilst the pod counts provide a useful indication of pod disease and levels of under-harvesting, they are approximate measures only and care must be taken in their interpretation for two reasons. First, dry pods can be distinguished from *Phytophthora* infected pods (Black Pod) by slight colour differences and the harder husks of dry pods, but it is more difficult to distinguish between them when *Phytophthora* infected pods are old or located on the upper branches of cocoa trees. Second, the ratio of diseased or dry pods to total pods per tree decreases as the period lengthens between a harvest round and the pod count following that harvest round. For dry pods, this relationship holds for up to two to three weeks, after which unharvested mature pods turn into dry pods. Thus, a cocoa tree harvested immediately before a count of diseased or dry pods will have fewer mature healthy pods in total than a tree that has not been harvested for two or more weeks.

5. To determine if an edge-effect were present, the first four cocoa trees into the block from the roadside edge (or house if located on the block) were analysed. This extends for a distance of approximately 30 to 50 m. The analysis was restricted to the first four cocoa trees because of the great variation in cocoa block shapes and sizes.
6. It should be pointed out that the number of extension visits is probably inflated because a CCI extension officer had a cocoa block at Tabaule. He visited his block on weekends and was sometimes called upon to give advice to neighbouring growers. A second extension officer had relatives living in one of the survey villages and was a regular visitor to his village on weekends. It is likely that he provided some extension advice to his relatives and neighbours.
7. Formation pruning is required to ensure up-right growth and sufficient branching.
8. In a workshop with extension officers in 2004 (see Chapter 2), one criterion which extension officers used to distinguish high producers from low producers was their willingness to apply extension advice to their management practices.

Chapter Eight

1. Some smallholders may also pool their wet bean with harvests from extended family members' plots to make up sufficient quantities for dry bean processing.
2. The harvest round may allow for harvesting of the whole block or a portion thereof.
3. Ghodake *et al.* (1995) noted this expansion of cocoa was motivated by the desire of farmers to secure ownership of land (see Chapter 4 for further discussion).
4. Block surveys conducted at Makurapau and Karavi villages in Kokopo District and Napapar 5, Napapar 4 and Ratongor villages in the Gazelle District.

Chapter Nine

1. This is especially the case for smallholders planting the new hybrid clones.
2. Some smallholders are averse to pruning because of the perceived short-term loss of income from the removal of branches.
3. In Papua New Guinea many cocoa plantations aim to replant 10% of their trees each year.
4. G. McNally estimates, based on cocoa plantation conditions, SG2 hybrids require 15 man days of labour per hectare for pruning each year. Some of the new hybrid clones require only 8 man days per year.
5. Kokonas Industri Koporesen is the government's policy and regulation authority for coconut products in PNG.
6. The section draws on Duigu & Omuru (2003). It has also greatly benefited from discussions with J. Duigu (J. Duigu and Associates) and G. McNally (NGIP-Newmark) who have been developing new extension models based on commercial sector partnerships with smallholders.
7. Moreover, the provision of transport for carting firewood to growers' processors in the intervening weeks between harvest pickups would encourage more farmers to process wet bean and thus benefit from value adding. It would also encourage regular harvesting.
8. The RDB in association with the ENB provincial authorities, the provincial Lands Department and CCI has recently commenced a pilot project of such a strategy at Bailu Plantation near Kokopo. The plantation, which has a heavy debt burden, was surveyed in 2007 and subdivided amongst 160 families, each of which is responsible for its share of the debt (Trudi Egi, RDB Kokopo, pers. comm., March 2007).

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